

11. RESOURCE REQUIREMENTS FOR ELECTRICAL ENGINEERING

11.1 Physical Resources

11.1.1 Space Requirement:

Norms and standards laid down by All India Council for Technical Education (AICTE) may be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

11.1.2 Equipment Requirement:

I. ELECTRICAL MACHINE LAB.

Sr. No.	Description	Qty
1.	Static Converter ,I/P-440 V AC, 50 Hz,O/P 0/50---240 V DC,50A Including Control Panel Board.	1
2.	A.C. & D.C.Electrical Machine Trainer (Complete Setup)	1
3.	Single and Three Phase Transformer Trainer Complete set up.	1
4.	3 KVA,440V,1500 rpm.,(3-Phase 4-Wire) Alternator coupled with 5 KW,220V DC.1500 rpm. DC Compound Motor including Control Panel Board.	2
5.	5 H.P.,220V DC,1500 rpm DC Shunt Motor Coupled with 3KW, 220V DC,1500 rpm DC Shunt Generator including Control Panel Board.	1
6.	3 HP ,230 V,1500 rpm Dc Shunt Wound Motor With loading arrangement & control Panel Board.	1
7.	3.5 KW,230 V,1500 rpm DC Series Motor Coupled with 3KW,230V,1500 rpm DC Shunt/Compound Generator including Control Panel Board.	1
8.	3H.P.,440V,50 Hz,1500 rpm. Slipping Induction Motor (with Rotor Resistance Starter) including Control Panel Board and its loading arrangement.	1
9.	3H.P.,440V,50 Hz,1500 rpm. Squirrel Cage Induction Motor having all Terminal on Terminal Box with Star/Delta Starter, Belt & Pully loading arrangement including Control Panel Board.	1
10.	3 KVA Synchronous Induction Motor 3-Phase,50 Hz,1500 rpm solid Yoke coupled to DC Generator 3.5 KW,230 V,1500 rpm including Control Panel Board.	1
11.	0.5 Kw Capacitor Sstart, Single Phase Induction Motorl,	1
12.	Multimeter Digital /Analog(for measurtement of ac voltage 0-1000v/dc voltage-0-750v, current 0-10 A	3
13.	Digital Clamp-On- meter Jaw Size 50 mm,ACA 20 A-1000 A, DCV 200 V-1000 V, ACV 200 V-700 V	2
14.	Digital Frequency Meter 0 -60Hz.	2
15.	Phase Sequance Meter (Disc Type)	2
16.	1 HP,220V1500rpm,50Hz Capacitor Start Induction Motor	2
17.	3KVA ,220/440 V,Single Phase air cooled Transformer housed in a Ventilated sheet metal case with all terminals out.	1
18.	3KVA ,440/220 V,Single Phase air cooled Transformer housed in a Ventilated sheet metal case.	1

19.	3KVA ,440/220 V,Three- Phase air cooled Transformer housed in a Ventilated sheet metal case with all winding terminals fixed on the transformer body.	1
20.	Auto-transformer(VARIC),Three-Phase- 4 Wire,15Amp, Continuously Variable, Housed in a Ventilated Sheet metal Case, Input-415 V Output-0-470 Volts.	1
21.	Auto-transformer(VARIC),Single- Phase, 12 Amp, Continuously Variable, Housed in a Ventilated Sheet metal Case, Input-230 V Output-0-270 Volts.	2
22.	Techometer Digital,Contact Type ,0-10000 r.p.m.	2
23.	Techometer Digital,Non-Contact Type , 0-10000 r.p.m.	2
24.	Techometer Analog,Contact Type ,0-10000 r.p.m.	2
25.	Varic Single phase ,16 A,In-put 230 Volts (AC),Out-Put 0--270 Volts (AC).	2
26.	Resistive Bank 3KW,440 V,Three Phase , Loading Rheostat housed in a well ventilated metal case with switches &Fuses , all connecting terminals fixed on the body	2
27.	Resistive Bank 3 KW,220 V,Single Phase , Loading Rheostat housed in a well ventilated metal case with switches &Fuses	2
28.	Inductive Load 3 KVA,440 V,Three Phase housed in a well ventilated metal case with switches &Fuses	2
29.	Variable Inductor,Single Phase,10 A (Step less variation)	1
30.	Capacitive Load 3 KVA,440V,Three Phase (With Step Variation)	2
31.	WATTMETERS:- Provided with Knife Edge Pointer mirror scale, Accuracy $\pm 1\%$:-Portable wattmeter,dynamometer Type,fitted in a wooden/PVC box 0.5 A, 300 /600V	2
32.	Portable wattmeter,dynamometer Type,fitted in a wooden/PVC box 0.5/1 A, 62.5/125/250 V	2
33.	Portable wattmeter,dynamometer Type,fitted in a wooden/PVC box 01/2 A, 300 V	2
34.	Portable wattmeter,dynamometer Type,fitted in a wooden/PVC box 2.5/5A, 75/150 V	2
35.	Portable,Wattmeter dynamometer type,,fitted in a wooden/PVC box 1.5/3A,150/300V	3
36.	Portable Wattmeter dynamometer type, fitted in a wooden/PVC box 5/10 A,300/600V	3
37.	Portable Wattmeter dynamometer type,fitted in a wooden/PVC box 10/20A,300/600V	4
38.	Portable Wattmeter dynamometer type, fitted in a wooden/PVC box 15/30A, 300 /600V	3
39.	L.P.F WATTMETERS Provided with Knife Edge Pointer mirror scale:- Portable Low Power factor (between 0.2 to 1) Wattmeter ,Analog,built in transducer, 1/2A/300 /600VV	2
40.	L.P.F WATTMETERS Provided with Knife Edge Pointer mirror scale:- Portable Low Power factor (between 0.2 to 1) Wattmeter ,Analog,built in transducer, 1.5/3 A,75/300/600 V	2
41.	Portable Low Power factor (between0.2 to 1) Wattmeter ,Analog,built in transducer, 20/30 A,75/300/600 V	2
42.	Portable power Factor Meter (0.5--1--0.5 range) :(Provided with Knife Edge Pointer mirror scale) , 0.5/1 A, 75/150/300V	1
43.	Portable power Factor Meter (0.5--1--0.5 range) :(Provided with Knife Edge Pointer mirror scale) , 2.5/5 A, 75/150/300 V	1

44.	Portable power Factor Meter (0.5--1--0.5 range) with Knife Edge Pointer mirror scale) , 5/10 A,150/300 /600V	2
45.	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0-2.5/5/10 A	3
46.	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0-1.5/2.5 A	3
47.	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0--3 A	4
48.	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0--5A	2
49.	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0-2.5/5 A	3
50.	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0-5/10 A	4
51.	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0-10/20 A	4
52.	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0-1000 m A	2
53.	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0--1/2 A	2
54.	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 5/10 A	2
55.	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0--2.5/5 A	2
56.	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 10/20 A	2
57.	Portable Moving Coil Voltmeter(DC), fitted in a wooden/PVC box 0--75/150 300 V	3
58.	Portable Moving Coil Voltmeter(DC), fitted in a wooden/PVC box, 0--300 / 600 V	2
59.	Portable Moving Iron Voltmeter(A.C), fitted in a wooden/PVC box, 0--75/150/300V	4
60.	Portable Moving Iron Voltmeter(A.C), fitted in a wooden/PVC box,0--300/600V	4
61.	Rheostat (Single Tube) With Carbon Contacts , OSWA :-25 Ω / 3 A,	2
62.	50 Ω / 2.8 A	2
63.	66 Ω / 2.8 A	2
64.	110 Ω / 1.5 A	2
65.	128 Ω / 2.3 A	2
66.	1165 Ω / 0.6 A	3
67.	500 Ω / 1A	3
68.	Rheostat (Double Tube) ,160 Ω / 2.8 A	2
69.	172 Ω / 2.8 A	2
70.	250 Ω / 1.8 A	2
71.	420 Ω / 1.8 A	3
72.	720 Ω / 1.4 A	2
73.	1350 Ω / 1 A	2

II. Electrical Work Shop

Sr No	Description	Qty. Reqd.
1	Hand cramping tool 10mm	2
2	Analog Multimeter	2
3	Digital Multimeter	2
4	Meggar 500V Digital/Analog	2

5	Energy meter single phase,220 V,10 Amp , 50Hz.	2
6	Energy meter Three phase,440 V,10 Amp , 50Hz.	1
7	Digital Clamp-On- meter Jaw Size 50 mm,ACA 0-200A, DCV 200 V-1000 V, ACV 200 V-700 V	2
8	3-Phase Induction Motor,1/4 HP,1440 rpm With All 6 Nos terminals at Terminal Box .	2
9	Cut View of 3- Phase induction motor	1
10	Automatic Fan/ Winding Machine with Coil Guides & Dies.	1
11	Automatic Transformer Coil Winding Machine. (Floor Model)	1
12	Cable Jionting Kit with Cable	1
13	Desert Cooler	1
14	Phase Sequence Indicator	1
15	Techometer Contact type.0---10000 rpm	1
16	D.O.L. Starter	1
17	Manual Operated Star-Delta Starter (For 3-5 HP)	1
18	Automatic Star-Delta Starter (For 3-5 HP)	1
19	Earth Tester Kit. (Digital)	1
20	Contractor 10A,230V (3N/O,2N/C)	2
21	Contractor 10A,230V (4N/O,3N/C)	3
22	Contractor 10A,415V (4N/O,3N/C)	2
23	Contractor 10A,415V (4N/O,3N/C)	2
	Distribution Box-8-way	2
	DP -63A	2
	MCB-6A	6
	MCB-16A	3
	ELCB-40A	1
24	Push Button 1N/O,1N/C	12
25	Timmer 0-120Sec	2
26	Over Loads Relay,0-5A,415 V	1
27	Over Loads Relay,0-5A,230 V	1
28	Electric Iron,750W,Light Weight	1
29	Electric Iron,1100W, (Automatic)	1
30	Table Fan	1
31	Emergency Light	2
32	Celling Fan,48"	1
33	Gyser,	1
34	Round Electric Oven (Automatic)	1
35	Immersion Rod 1500 W	2
36	Heat Convector	1
37	Washing Machine(Semi Automatic)	1
38	Vacume Cleaner	1
39	Mixer Grinder 1000W	1
40	Room Heater (Double Rod)	1
41	Electric Kettle 1000 Watt	1
42	Bench Drilling Machine 3/4", Adjustable Plateform	1
43	Portable Drilling Machine with Stand 1/2"	1
44	Zig Saw Heheay Duty	1
45	Lead Acid Battery 12V, 63 AH	1
46	Battery Charger 12/24V,5A	1

47	Hydrometer	2
48	Auto Transformer 0-270V,12A	1
49	Single Phase double Edge Grinder 8"	1
50	Pully Puller	1
51	Bearing Puller	1
52	Growler	1
53	Battery Cell Tester	1
54	Portable Moving Iron Voltmeter(A.C), fitted in a wooden/PVC box,0--300/600V	1
55	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0-- 5/10 A	1
56	Portable Wattmeter dynamometer type,fitted in a wooden/PVC box 2.5/5A,300/600V	2
57	Elan-Key Set	1
58	Small Hacksaw Frame 6"	2
59	Hacksaw Frame 14"	2
60	Soldering Iron 35W	2
61	Soldering Iron 65W	3
62	Soldering Iron 125W	1
63	Centre Punch	2
64	Blow Lamp	2
65	Twizer	4
66	Wire Striper	2
67	Screw Driver Set- 10"	2
68	Screw Driver Set- 12"	2
69	Combination Plier 8"	6
70	Nose Plier 6"	4
71	Flate Nose Plier 6"	4
72	Rached Socket Set	1
73	Nut Driver Set 6"	2
74	Nut Driver Set 8"	2
75	Pop Spaner	2
76	Line Tester 500V	4
77	Cable Cutter	1
78	Wooden Saw 12" -----	3
79	Deep Hole Saw	2
80	Key Hole Saw	2
81	Hammer 200 gm.	3
82	Ball Pin Hammer	3
83	Wooden Chisel (Mortail) 4,6Soot	3
84	Wooden Chisel (Firmer) 3/4",1"	2
85	Raship File Half Round 10"	4
86	Raship File Round 10"	2
87	Flate File ,(Smooth) 10"	2
88	Flate File ,(Rough) 10"	2
89	Round File,(Smooth) 10"	2
90	Round File,(Rough) 10"	2
91	Half Round File,(Smooth 10"	2
92	Half Round File,(Rough) 10"	2
93	Square file,(Smooth) 10"	2
94	Square file,(Rough) 10"	2
95	Triangular File(Smooth) 10"	2
96	Triangular File(Rough) 10"	2
97	Standerd Wire gauge(British)	1

98	Spanner Set	1
99	Try Square 6"	1
	Bench Vice 3"	1
	Bench Vice 5"	1
	Pipe Bench Vice 2"	1

III. ELECTRICAL POWER LAB.

Sl. No.	Name Of Item/Spec.	Quantity
1	Oil Testing Set input 230V, Out Put 0-50 KV, 2KV/Sec.	1
2	Current Transformer (20/5A)	4
3	Potential Transformer 440 / 110 Volts	4
4	MCBs-single pole-6A	4
5	MCB triple pole-6A	4
6	Demonstration Model of Earthing	1
7	Power Analyzer	1
8	Lux Meter	2
9	Fluorescent lamp assembly	4
10	HP mercury vapour lamp assembly	4
11	HP sodium vapour lamp assembly	4
12	CFL Of different ratings	2 each
13	Working Model Of Refregeneration	1
14	Working Model Of Air-conditioner	1
15	Working Model Of induction furnace	1
16	Working model of electroplating plant	1
17	Various types of electrical u/ground cables samples	4 each
18	Electrical cable fault locator	1
19	Energy auditor trainer 3-Phase ,4 Wire balanced & unbalanced load ,RS485 to 232 software converter alongwith accessories	1

IV. ADVANCED ELECTRONICS LAB.(DIGITAL & POWER ELECTRONICS)

S. No	Name of Equipment	Detail Specification	Qty required	Experiment covered
1	Experimental Board.	Experimental Trainer Board comprising of experimental setup for performing V-I characteristics of SCR. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities: 1. In built power supply with indicator 2 On/Off switch	04	V-I Characteristics of SCR

		<p>3. Protection against high current and transients..</p> <p>4. Operating manual with detail procedure and specifications of components used .</p> <p>5. Suitable numbers of Banana Patch cord (min. 4 mm) required for the ETB.</p>		
2	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for performing V-I characteristics of TRIAC. The whole experimental set up must be marked (printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <p>1. In built power supply with indicator</p> <p>2 On/Off switch</p> <p>3. Protection against high current and transients.</p> <p>4. Operating manual with detail procedure and specifications of components used .</p> <p>5. Suitable numbers of Banana Patch cord (min. 4 mm) required for the ETB.</p>	04	V-I Characteristics TRIAC.
4	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for UJT Characteristics. The whole experimental set up must be marked (printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <p>1. In built power supply with indicator</p> <p>2 On/Off switch</p> <p>3. Protection against high current and transients.</p> <p>4. Operating manual with detail procedure and specifications of components used .</p> <p>5. Suitable numbers of Banana Patch cord (min. 4 mm) required for the ETB.</p>	04	UJT Characteristics.
5	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for UJT Relaxation Oscillator. The whole experimental set up must be marked (printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <p>1. In built power supply with indicator</p> <p>2 On/Off switch</p> <p>3. Protection against high current and transients.</p> <p>4. Provision for observing input/output waveforms on CRO</p> <p>5. Operating manual with detail procedure and specifications of components used .</p> <p>6. Suitable numbers of Banana Patch cord (min. 4 mm) required for the ETB.</p>	04	UJT Relaxation Oscillator circuit.
6	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental set up for Thyristor based</p>	04	Illumination

		<p>Illumination Control Circuit. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients.. 4.Operating manual with detail procedure and specifications of components used . 5.Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 		control circuit
7	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup Fan Speed Regulator circuit using Triac & Diac.The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4.Operating manual with detail procedure and specifications of components used . 5.Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 	04	Fan speed regulator circuit
8	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup Speed Control of DC Shunt Motor or Universal motor using Thyristor based control. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4.DC motor/universal motor of suitable rating. 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 	04	Speed control of DC motor or universal motor using Thyristor
9	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental set up for SCR based single phase half controlled full wave rectifier. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1.In built power supply with indicator 	04	Single phase half controlled rectifier circuit using SCR

		<ul style="list-style-type: none"> 2 On/Off switch 3. Protection against high current and transients. 4. Provision for observing waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord (min. 4 mm) required for the ETB. 		
10	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for SCR based single phase fully Controlled Rectifier Circuit. The whole experimental set up must be marked (printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ul style="list-style-type: none"> 1. In built power supply with indicator 2 On/Off switch 3. Protection against high current and transients. 4. Provision for observing waveforms on CRO 4. Operating manual with detail procedure and specifications of components used . 5. Suitable numbers of Banana Patch cord (min. 4 mm) required for the ETB. 	04	Single phase fully controlled rectifier circuit using SCR
11	Experimental Board	<p>Experimental Trainer Board comprising of Experimental setup for three phase uncontrolled rectifier circuit. The whole experimental set up must be marked (printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ul style="list-style-type: none"> 1. In built power supply with indicator 2 On/Off switch 3. Protection against high current and transients. 4. Provision for observing waveforms on CRO 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord (min. 4 mm) required for the ETB. 	04	Three Phase Uncontrolled rectifier
12	Experimental Board	<p>Experimental Trainer Board comprising of Experimental setup for Thyristor Based Three phase Controlled rectifier circuit. The whole experimental set up must be marked (printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ul style="list-style-type: none"> 1. In built power supply with indicator 2 On/Off switch 3. Protection against high current and transients. 4. Provision for observing waveforms on CRO 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord (min. 4 	04	Thyristor Based Three Phase Controlled rectifier

		mm) required for the ETB.		
13	Experimental Board	Experimental Trainer Board comprising of Experimental setup for Verification of Truth Table for AND(7408),OR(7432),NOT(7404),NAND(7400) NOR(7402),EX-OR(7486),EX-NOR Gates. The whole experimental set up must be marked(printed) on the sheet in the form of logic diagram and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities: 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4. Provision for logic inputs with display, seven segment display, output display(LEDs),logic pulser, common power supply and common ground. 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord required for the ETB.	04	Logic Gates.
14	Experimental Board	Experimental Trainer Board comprising of Experimental setup for Construction of Half Adder . The whole experimental set up must be marked(printed) on the sheet in the form of logic diagram and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities: 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4. Provision for logic inputs with display, output display(LEDs), 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord required for the ETB.	04	Half Adder circuit.
15	Experimental Board	Experimental Trainer Board comprising of Experimental setup for Full Adder Circuit . The whole experimental set up must be marked(printed) on the sheet in the form of logic diagram and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities: 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4. Provision for logic inputs with display, output display(LEDs). 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord required for the ETB.	04	Full Adder circuit

16	Experimental Board	Experimental Trainer Board comprising of Experimental setup for study of Flip Flops(RS,J-K, master slave J-K,D and T). The. whole experimental set up must be marked(printed) on the sheet in the form of logic diagram and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities: 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4. Provision for logic inputs with display, output display(LEDs). 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord required for the ETB.	02 each Total =(12)	Flip-Flops
17	Experimental Board	Experimental Trainer Board comprising of Experimental setup for 3-bit Asynchronous Up-Counter, down counter and Universal Counter, 3-bit synchronous counter(up-down). The. whole experimental set up must be marked(printed) on the sheet in the form of logic diagram and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities: 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4. Provision for logic inputs with display, output display(LEDs),. 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord required for the ETB.	2 each (8 no)	Asynchronous counters
18	Experimental Board	Experimental Trainer Board comprising of Experimental setup for Analog to Digital Converter. The. whole experimental set up must be marked(printed) on the sheet in the form of logic diagram and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities: 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4. Provision for Analog inputs, output display(LEDs),. 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord required for the ETB.	04	ADC
19	Experimental Board	Experimental Trainer Board comprising of Experimental setup for Digital to Analog Converter . The. whole experimental set up must	04	DAC

		<p>be marked(printed) on the sheet in the form of logic diagram and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4. Provision for logic inputs with display and output terminals for output voltage measurement. 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord required for the ETB. 		
20	Powerscope	Powerscope BW-40MHZ	02	Powerscope for power electronics lab
21	PLC Trainer along with computer interfacing terminal	Programmable Logic Controller No. of inputs = 16 No. of outputs = 8 Along with the provision of at least 10 compatible application modules(as per the requirement)	02	PLC
22	DC Regulated Power Supply	DC Regulated power supply Input- 230 V AC Output – 0-30 V DC, 1A/3A/5A Provision of Voltage & Current indication with digital display Protection against over voltage/over current. and transients.	04each	Where ever required in the lab for performing experiment.
23	DC Regulated Power Supply	Regulated Dual power supply 30 V / 2 amp +/- 12 V,+/- 15V/ 1amp, 5V/ 5amp Protected against over load and short ckt adjustable current limiter.	4	--do-
24	Analog Multimeter	Analog Multimeter AC/DC voltage & current , resistance measurement AC voltage 0-1000/2500 V Current range micro ampere – 10 A Resistance range up to Mega Ohms Protection against over voltage/ over current	4	--do-
25	Digital Multimeter	Digital multi meter DCV: 200mV-1000V ACV: 200mV-1000V Resistance : 200Ω-20MΩ AC/DC current : 200mA –10A Diode and continuity check	4	--do-

		Overload protection in all ranges should be provided		
26	Analog Voltmeter	Analog Voltmeter, 0-30/75/150/300V AC/DC Electro-dynamometer type with IS standard Accuracy $\pm 0.5\%$, suitably fitted in teak boxes.	4	--do-
27	Analog Ammeter	Analog Ammeters, AC/DC, Electro-dynamometer type with IS standard. Range 5/10 A, Accuracy $\pm 0.5\%$, suitably fitted in teak boxes.	4	--do-
28	CRO	Dual Trace CRO 30 M Hz X-Y mode With component tester Sweep magnification * 10, 2-level calibrator	4	--do-
29	IC Tester	UNIVERSAL IC TESTER IC PACK : Digital ICs up to 40 pins and analog ICs up to 20 pins in DIP package. IC TYPE : Tristate, open collector & bidirectional TTL/CMOS digital ICs also analog ICs as per list. TEST BY : Truth table comparison for digital ICs. Functional test of output for various input conditions for analog ICs. ZIF : 20 pin DIP ZIF for analog ICs and 40 pin Universal ZIF for digital ICs. KEY : 24 keys DISPLAY : 16 character x 2 line SUPPLY VOLTAGE : 230V AC.	2	--do-
30	Function Generator	Range 0.3 Hz to 3 MHz with Sine , Square , Triangle , DC 15 MHz Frequency Counter DC Offset adjustment CMOS and TTL Trigger Output Internal Sweep and External FM Modulation Distortion Factor < 0.5% Square Wave Rise time typ. 70 ns 5 digit LED Display	4	--do-
31	LCR-Q meter	4 digit LED Display , Auto ranging Basic Accuracy :0.25% Resistance : 0.001 Ω to 100 M Ohm Inductance : 0.1uH to 9999H Capacitance : 0.1pF to 999uF Q : 0-99	1	--do-
32	Soldering /De-soldering station	SOLDERING STATION /De soldering station Read Out Easy to read digital temperature display ESD Safe feature & P.T.C Sensor to insure accurate temperature Temperature stability accuracy ± 3 degree C (6 degree F) Heat up & Recovery Top grade ceramic heating element should provide with fast heat up , fast	02	--do-

		recovery and exciting temperature control. Spike Free circuitry. High Insulation superior ceramic heater with external calibration port should provided for temperature adjustment. Temperature Range : 200 degree C to 480 degree C		
33	Soldering iron	Soldering iron, 25/35/60 W	2 each	--do-
34	Frequency counter	Frequency Range 0.1Hz to 1 GHz , Resolution (Selectable) , Sensitivity 20mV max. Period measurement from 1uS to 100 s & Event Counting features 8 Digit LED Display. Leading Zero Suppression	2	
35	Pulse generator	Range : 2 Hz to 20 MHz (7 decade steps) Pulse duration :20 ns-200ms Rise Time < 3ns Two Separate O/P (+/-) Single Pulse Capability Indicator Width > Period	2	
36	Tool kit & accessories	Tool kit comprising screw driver set, watch makers screw driver set, tweezers, pliers, nose pliers, wire cutters, wire strippers, hammers, steel rules, markers, portable hand held drilling machine, hacksaw, test pen,	As per requirement	
37	Bread Board	Bread boards of different sizes	10	
38	Logic pulser	Logic pulser/Analyser	2	
39	Electronic Components	Electronic components such as SCR, TRIAC, DIAC, UJT, SCRS, SUS, PUT, MOSFET ,POWER TRANSISTERS, IGBTs	As per requirement	
40	Digital ICs	Digital ICs for logic gates, OPAMP, Counters, Mux-DeMux, and all other ICs for combinational & sequential circuits as required	4 Each	
41	Component storage rack	Component storage rack for components used in power electronics & digital electronics lab	01	
42	Display Boards	Display boards for power electronic components and digital ICs	One each	
43	Auto Transformer	Auto transformer Input- 230 V AC, 50 Hz Output – 0 to 270 V AC, 8 A	2	
44	Desk top Computers	Desktop Computers of latest configurations with printer	As per requirement	

Note :- Quantities of items listed above are meant for the group of maximum 20 students in the lab.

V. BASIC ELECTRONICS LAB.(I & II)

S.No	Name of Equipment	Detail Specification	Qty required	Experiment covered
1	Experimental Board.	<p>Experimental Trainer Board comprising of experimental setup for performing V-I characteristics of semiconductor diode(Silicon & Germanium).The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Inbuilt measuring instruments of suitable range for taking measurements of required parameters for the experiments. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	04	V-I Characteristics of semiconductor diode.
2	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for performing V-I characteristics of Zener Diode. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Inbuilt measuring instruments of suitable range for taking measurements of required parameters for the experiments. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	04	V-I Characteristics of Zener diode.
3	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for performing V-I characteristics of Field Effect Transistor. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with</p>	04	V-I Characteristics of Field Effect

		<p>specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Inbuilt measuring instruments of suitable range for taking measurements of required parameters for the experiments. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		Transistor.(FET)
4	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for observing input and output wave shapes of Half Wave rectifier circuit .The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision to observe the waveform(i/o) on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	04	Input, output wave shapes of Half Wave Rectifier Circuit.
5	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for observing input and output wave shapes of a full wave(Center tap & Bridge type) rectifier circuit. The whole experimental set up must be marked printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO 	04	Observing input and output wave shapes of a full wave rectifier circuit (center tap & Bridge type).

		<ol style="list-style-type: none"> 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		
6	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for Capacitor, Inductor and Pai filter circuits. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	04	Filter circuits
7	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for Input & Output Characteristics of Transistor(NPN&PNP) in Common Base configuration mode.The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Inbuilt measuring instruments of suitable range for taking measurements of required parameters for the experiments. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	04	Input and output characteristics of Transistor in Common Base configuration mode.
8	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for input & output characteristics of Transistor in Common Emitter mode. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with</p>	04	Input & Output Characteristics of

		<p>specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Inbuilt measuring instruments of suitable range for taking measurements of required parameters for the experiments. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		Transist or (NPN&P NP) in CE mode
9	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for performing experiment on Measurement of operating point in fixed biased and potential divider transistor biasing circuits.The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Inbuilt measuring instruments of suitable range for taking measurements of required parameters for the experiments. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	2 each	Transist or biasing circuits
10	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for Single stage Transistor Amplifier Circuit(CE mode).The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 	04	Single stage transistor Amplifier circuit

		<ol style="list-style-type: none"> 4. Provision for observing waveforms(i/o) on CRO 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		
11		<p>Experimental Trainer Board comprising of Experimental setup for performing Two stages RC coupled transistor amplifier circuit. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing waveforms(i/o) on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	04	Two stages RC coupled amplifier circuit.
12	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for measuring optimum load, output power and signal handling capacity of Push-Pull Amplifier circuit. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used.\ 	04	Push – Pull amplifier circuit.
13	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for single stage CE transistor amplifier circuit with negative feedback circuit using emitter by-pass</p>	02	Amplifier circuit using negative

		<p>capacitor. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		feedback.
14	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for Hartley Oscillator Circuit. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02	Hartley Oscillator Circuit.
15	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for R-C Phase shift Oscillator Circuit The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 	02	R-C Phase-shift Oscillator circuit.

		<ol style="list-style-type: none"> 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		
16	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for R-C Differentiator circuit. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02	R-C differentiator circuit
17	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for R-C Integrator Circuit The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02	R-C integrator circuit
18	Experimental Board.	<p>Experimental Trainer Board comprising of Experimental setup for Positive & negative Clipper Circuit using diodes and DC power supply. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p>	02	Clipper circuits

		<ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		
19	Experimental Board	<p>Experimental Trainer Board comprising of Experimental setup for Clipper circuit using Zener diode. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02	Clipper circuit using Zener diode
20		<p>Experimental Trainer Board comprising of Experimental setup for positive & negative clamper Circuit The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02 each	Clamper circuit
21		Experimental Trainer Board comprising of Experimental setup for Astable Multivibrator	02	Astable multivibr

		<p>Circuit The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		ator circuit
22		<p>Experimental Trainer Board comprising of Experimental setup for Mono stable Multi vibrator Circuit The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02	Mono stable multi vibrator circuit
23	Experimental Board	<p>Experimental Trainer Board comprising of Experimental setup for Bi-Stable multivibrator Circuit The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 	02	Bi-stable Multivibrator circuit

		<ol style="list-style-type: none"> 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 		
24	Experimental Board	<p>Experimental Trainer Board comprising of Experimental setup for working of Operational Amplifier Circuit (741) as an adder, Comparator, Integrator & Differentiator. The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02	741 OP-AMP
25	Experimental Board	<p>Experimental Trainer Board comprising of Experimental setup for Mono stable & astable, bi-stable multivibrator circuit using IC 555.The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure. The board must include the following facilities:</p> <ol style="list-style-type: none"> 1. In built power supply with indicator 2. On/Off switch 3. Protection against high current and transients. 4. Provision for observing input/output waveforms on CRO. 5. Operating manual with detail procedure and specifications of components used . 6. Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7. Quality check and calibration certificate for meters used. 	02 each	Multivibrator circuit using IC 555.
26	Experimental Board	<p>Experimental Trainer Board comprising of Experimental setup for Realization of regulated power supply using 7805,7905,7915 The whole experimental set up must be marked(printed) on the sheet (PCB sheet) with specification of each component used and should be duly housed in a suitable metallic/robust enclosure.</p>	02	Regulated power supply using ICs.

		The board must include the following facilities: 1.In built power supply with indicator 2 On/Off switch 3.Protection against high current and transients. 4.Provision for observing input/output waveforms on CRO. 5.Operating manual with detail procedure and specifications of components used . 6.Suitable numbers of Banana Patch cord(min. 4 mm) required for the ETB. 7Quality check and calibration certificate for meters used.		
27	Electronic Components	Electronic Components (Resistors, inductors, capacitors, diodes, zenor diodes, thyristers, switches , LEDs of different types/ratings)	As per requirement	
28	Component storage rack	Electronic Components storage rack of requisite size.	2	
29	Display boards	Electronic components display boards	One each for each component	
30	DC Regulated Power Supply	DC Regulated power supply Input- 230 V AC Output – 0-30 V DC, 1A/3A/5A Provision of Voltage & Current indication with digital display Protection against over voltage/over current. and transients.	02 each	Where ever required in the lab for performing experiment.
31	DC Regulated Power Supply	Regulated Dual power supply 30 V / 2 amp +/- 12 V,+/- 15V/ 1amp, 5V/ 5amp Protected against over load and short ckt adjustable current limiter.	4	--do-
32	Analog Multimeter	Analog Multimeter AC/DC voltage & current , resistance measurement AC voltage 0-1000/2500 V Current range micro ampere – 10 A Resistance range up to Mega Ohms Protection against over voltage/ over current	6	--do-
33	Digital Multimeter	Digital multi meter DCV: 200mV-1000V ACV: 200mV-1000V Resistance : 200Ω-20MΩ AC/DC current : 200mA –10A Diode and continuity check Overload protection in all ranges should be provided	6	--do-
34	Analog Voltmeter	Analog Voltmeter, 0-30/75/150/300V AC/DC Electrodynamometer type with IS standard	4	--do-

		Accuracy +/- 0.5%, suitably fitted in teak boxes.		
35	Analog Ammeter	Analog Ammeters, AC/DC, Electro-dynamometer type with IS standard. Range 5/10 A, Accuracy +/- 0.5%, suitably fitted in teak boxes.	4	--do-
36	CRO	Dual Trace CRO 30 M Hz X-Y mode With component tester Sweep magnification * 10, 2-level calibrator	5	--do-
37	Digital storage Oscilloscope	Digital storage Oscilloscope Bandwidth = 50 M Hz Trigger BW : 0-100MHz	1	--do--
38	Audio signal generator	Audio Signal generator, Sine & square wave generator 0-10V o/p 0-200kHz frequency range Analog/Digital display	5	--do-
39	Function Generator	Range 0.3 Hz to 3 MHz with Sine , Square , Triangle , DC 15 MHz Frequency Counter DC Offset adjustment CMOS and TTL Trigger Output Internal Sweep and External FM Modulation Distortion Factor < 0.5% Square Wave Rise time typ. 70 ns 5 digit LED Display	2	--do-
40	LCR-Q meter	4 digit LED Display , Auto ranging Basic Accuracy :0.25% Resistance : 0.001 Ω to 100 M Ohm Inductance : 0.1uH to 9999H Capacitance : 0.1pF to 999uF Q : 0-99	1	--do-
41	Soldering /De-soldering station	SOLDERING STATION /De soldering station Read Out Easy to read digital temperature display ESD Safe feature & P.T.C Sensor to insure accurate temperature Temperature stability accuracy \pm 3 degree C (6 degree F) Heat up & Recovery Top grade ceramic heating element should provide with fast heat up , fast recovery and exciting temperature control. Spike Free circuitry. High Insulation superior ceramic heater with external calibration port should provided for temperature adjustment. Temperature Range : 200 degree C to 480 degree C	02	--do-
42	Soldering iron	Soldering iron, 25/35/60 W	2 each	--do-
43	Frequency counter	Frequency Range 0.1Hz to 1 GHz , Resolution (Selectable) , Sensitivity 20mV	2	

		max. Period measurement from 1uS to 100 s & Event Counting features 8 Digit LED Display. Leading Zero Suppression		
44	Distortion factor meter	DISTORTION METER Freq. Range : 20 Hz to 20 kHz (3 decade steps) 3 digit LED display Resolution : 0.01% (max.) Automatic Frequency Fine Tuning Input Impedance : 100kOhm Attenuator :20 db/- 10db Monitor O/P for distortion Analysis.	2	
45	Tool kit & accessories	Tool kit comprising screw driver set, watch makers screw driver set, tweezers, pliers, nose pliers, wire cutters, wire strippers, hammers, steel rules, markers, portable hand held drilling machine, hacksaw, test pen,	As per requirement	
46	Bread Board	Bread boards of different sizes	10	
47	Auto Transformer	Auto transformer Input- 230 V AC, 50 Hz Output – 0 to 270 V AC, 8 A	2	

Note :- Quantities of items listed above are meant for the group of maximum 20 students in the lab

VI. ELECTRICAL MEASUREMENT LAB.(FOR BATCH OF 20 STUDENTS)

Sr No	Description	Qty. Reqd.
1	Dual Regulated DC Power Supply 0--30 Volts,0- 2Amp.with Digital /Analog (V&A) Pannel meters Of 3½ Digit With Short Circuit protection.	2
2	Energy meter single phase,220 V,10 Amp , 50Hz.	2
3	Energy meter Three phase,4400 V,10 Amp , 50Hz.	2
4	Multimeter Digital,Range 750 V DC,1000V AC,10 Amp.	2
5	Multimeter Analog, Lab Model, Range 750 V DC,1000V AC,10 Amp.	2
6	Digital Clamp-On- meter ,ACA 0 -200 A, DCV 0-750V, ACV 0-1000 V	2
7	Galvanometers 30--0--30 Fitted on bakelite stand with two terminals (Sensitivity 20µA/div, Accuracy ±1.5% of FSD)	2
8	Electronic earth tester (with complete Kit) 0-2/10Ω - 100/1000Ω Range	2
9	Megger/Insulation Tester 500 V,50MΩ (Analog)	2
10	C.R.O. Dual Beam 20 MHz	2
11	LRC Meter, (Bench Model)	2

12	Digital Frequency Meter,1Hz to 100Hz.	2
13	Current Transformer (20:5, VA= 5,line Voltage 220 V)	2
14	Potential Transformer 200VA, 440 / 110 Volts (In: 0-380-400-440 V, Out: 110V)	2
15	Auto-transformer(VARIC),Three Phase, 20 Amp, Continuously Variable, Housed in a Ventilated Sheet metal Case, Input-415 V Output-0-470 Volts.	2
16	Auto-transformer(VARIC),Single- Phase, 8/12 Amp, Continuously Variable, Housed in a Ventilated Sheet metal Case, Input-230 V Output-0-270 Volts.	2
17	WATTMETERS:- Provided with Knife Edge Pointer mirror scale, Accuracy $\pm 1\%$:-Portable wattmeter,dynamometer Type,fitted in a wooden/PVC box 0.5 /1A, 125/250/500V	2
18	Portable wattmeter,dynamometer Type,fitted in a wooden/PVC box 2.5/5A, 75/150/300 V	2
19	Portable Wattmeter dynamometer type, fitted in a wooden/PVC box 2.5/5 A,300/600V	3
20	Portable Wattmeter dynamometer type,fitted in a wooden/PVC box 5/10A,300/600V	2
21	Portable Low Power factor (between 0.2 to 1) Wattmeter ,Analog,built in transducer, 1.5/3 A,300/600 V	2
22	Portable power Factor Meter (0.5--1--0.5 range) : (Provided with Knife Edge Pointer mirror scale) , 0.5/1 A, 75/150/300V	2
23	Portable power Factor Meter (0.5--1--0.5 range: (Provided with Knife Edge Pointer mirror scale) , 2.5/5 A, 75/150/300 V	2
24	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0- 500/1000 μ A (Provided with Knife Edge Pointer mirror scale)	2
25	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 500/1000mA	4
26	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0--1 A	4
27	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0- 1.5 A	4
28	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0- 1.5/2.5 A	4
29	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0--3A	2
30	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0- 2.5/5 A	2
31	Portable Moving Coil Ammeter(DC), fitted in a wooden/PVC box 0- 5/10 A	2
32	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0-1000 mA(Provided with Knife Edge Pointer mirror scale)	4
33	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0--1/2 A	2

34	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0- 1.5/2.5 A	2
35	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0-- 2.5/5 A	2
36	Portable Moving Iron Ammeter(AC), fitted in a wooden/PVC box 0- 5/10A	2
37	Portable Moving Coil Voltmeter(DC), fitted in a wooden/PVC box 0--500/1000 mV	2
38	Portable Moving Coil Voltmeter(DC), fitted in a wooden/PVC box 0--75/150 V	2
39	Portable Moving Coil Voltmeter(DC), fitted in a wooden/PVC box 0--25/50V	2
40	Portable Moving Iron Voltmeter(A.C), fitted in a wooden/PVC box 0--1000mV (Provided with Knife Edge Pointer mirror scale)	2
41	Portable Moving Iron Voltmeter(A.C), fitted in a wooden/PVC box 0--75V	2
42	Portable Moving Iron Voltmeter(A.C), fitted in a wooden/PVC box, 0--150/300V	2
43	Portable Moving Iron Voltmeter(A.C), fitted in a wooden/PVC box,0--300/600V	4
44	Inverter 3 KVA,	1
45	Rheostat (Single Tube) With Carbon Contacts , OSWA :-25 Ω / 3 A	2
46	50 Ω / 2.8 A	2
47	66 Ω / 2.8 A	2
48	110 Ω / 1.5 A	2
49	128 Ω / 2.3 A	2
50	500 Ω / 1A	2
51	Rheostat (Double Tube)250 Ω / 1.8 A	2
52	420 Ω / 1.8 A	2
53	720 Ω / 1.4 A	2
54	Fixed / Standard Resistance coil Cased in bakelite / Tick Wooden Case with Two Lock Type Terminals For Connection:- 2 Ω /10 Watt.	4
55	5 Ω /10 Watt.	4
56	10 Ω /2 Watt.	4
57	20 Ω /1/2 Watt.	4
58	50 Ω / 1/2Watt.	4
59	Fractional Resistance Box,Plug Type 1 Ω to 10 Ω	2
60	Fractional Resistance Box,Plug Type 10 Ω to 100 Ω	2
61	Inductive Coil 0.1H, 25 Ω /2.5 A (With Air core & Iron Core)	4
62	Resistive Bank 2 KW,220 V,Single Phase , Loading Rheostat housed in a well ventilated metal case with switches &Fuses (With Step Variation)	2
63	Inductive Load 2 KVA,220 V,Single Phase housed in a well ventilated metal case with switches &Fuses(Having Step Variation)	2
64	Capacitive Load 2 KVA,220 V,Single Phasehoused in a well ventilated metal case with switches &Fuses (With Step	2

	Variation)	
65	Resistive Bank 3 KW, Three Phase , Loading Rheostat housed in a well ventilated metal case with switches & Fuses (With Step Variation)	2
66	Inductive Load 3 KVA, Three Phase housed in a well ventilated metal case with switches & Fuses (Having Step Variation)	2
67	Experimental board for verification of Electrical laws & network theorems . The board should have components to perform the following :-1. Verification of Ohm's Law. 2. Verification of Kirchoff's law. 3. Series & parallel resistances. 4. Various Network theorems. 5. Resonance Circuit	2 Each
68	Audio signal generator	2
69	Lead acid battery, 12V, 120 ampere hours, Hard rubber housing	1
70	Battery charger for charging 12V lead acid battery, Input, 220 V 1-phase power supply Output, 12 V Charger having the facility of auto cut, overload, short circuit protection and alarms for supply on/off, various charging conditions and panel meters for voltage & current indications.	2
71	Hydrometer/sp. Gravity checker	2
72	Cell discharge tester for lead acid battery.	2
73	Stop watch (digital)	2
74	Maximum Demand Indicator suitable for 3-Phase 4-wire 3x230V AC, 50 Hz unbalanced Load C.T. operated 100/5A	1
75	Standard Wire Gauge	2
76	Shunts resistances of different values.	2
77	Multiplier resistances of different values.	2

11.1.2 Space Requirement:

Norms and standards laid down by All India Council for Technical Education (AICTE) may be followed to work out space requirement in respect of class rooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

11.1.3 Furniture Requirement

Norms and standards laid down by AICTE be followed for working out furniture requirement for this course.

11.2 Human Resources:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, work load norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE