

10. RESOURCE REQUIREMENT

10.1 PHYSICAL RESOURCES

(a) Space requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) are to 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.

(b) Equipment requirement:

Sr No	Particulars	Qty.	Estimated Price (Rs)
1.	BASIC ELECTRICITY AND MEASUREMENT LABORATORY		
1.1	Measuring Instruments: Portable moving coil permanent magnet 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in teak wood/ebonite case, accuracy 1.5%		
	a) Ammeter 0-5-10 Amp	8	10,000
	b) Ammeter 50 mA , 100 mA, 1000 mA	6	7,200
	c) Ammeter 0-10 Amp – 20 A	6	7,200
	d) Ammeter 0 -2.5- 5 Amp	8	10,000
	e) Voltmeter 0-30 V	8	10,000
	f) Voltmeter 0-10-15 V, 0-200 – 300 V, 0-200-500 V	6	7,200
1.2	Stabilized DC Power Supply With maximum regulation of 0.01 to 0.05% Ripple in output less than 1 mv (rms), stability 0.2%+ 30 mV, input supply 230V AC single phase, 50 Hz and DC output 0-10V,0-1.5A and also with short circuit (0-30 V) and over load protection with measuring devices	8	32,000
1.3	Lead Acid Batteries 12 V, 11 plates, 30 amp hour capacity	2	6,000
1.4	Battery Charger: SCR based automatic 12 V, AC input voltage 230 V, output dc voltage 0-12 V, 0-2 amp. capacity provided with voltmeter, Ammeter of suitable range	1	3,000
1.5	Sliding Rheostats: Wound with evenly oxidised iron free Nickel copper wire on vitreous enamelled round steel tube. Contactors should be of laminated phosphor bronze sheet, Resistance tolerance ranges +20% or 5% double tube	2	3,000

Note: The prices indicated again each item are suggestive as these are based on data collected in the year 2009 and therefore, necessary correction may be made for use in prices during these years

Sr No	Particulars	Qty.	Cost in Rupees
1.6	Standard Resistance: 0.01 ohm, 10 amp. Fixed on bakelite base with brass terminals, 4 terminal arrangement, immersed in moisture free oil contained in a vessel sealed from the top	2	400
1.7	Decade Resistance Boxes: Constantan coils, Accuracy $\pm 0.5\%$ to 1% single dial 10x10x10, 10x1000, 10 x10000 ohms.	1	1,000
1.8	Capacitors: enclosed in a polished hard wood/bakelite box, with four brass terminals	6	1800
1.9	Resistance Box: Constantan coils ratings 1 ohm to 10 megohm	1	500
1.10	Spot Reflecting Galvanometer: Housed in bakelite case with lamp scale arrangement, Taut band type movement, shock proof, scale 150 mm long lamp operated on 220 V, AC mains, with shunt multiplying power of 1/10, 1/100, 1/1000, Resistance 125 ohm, sensitivity 0.04 micro amp. per mm, critically damped, time period 2 sec.	1	4,000
1.11	Hydrometer for measuring specific gravity of lead acid battery range 1100 - 1300	6.	1,000
1.12	Cell discharge tester: used for testing voltages of cells and batteries centre zero, housed in bakelite case with wooden handle movement, permanent magnet and moving coil type, knife edge pointer, range 3-0-3 volts	1	600
1.13	Digital Multimeter: Three and half digits LCD display, manually operated multimeter with AC/DC, 1A current resistance upto 10 Mohm, complete with leads manual and batteries, accuracy 0.5% for dc and 1% for AC measurement Voltage upto 1000V	1	750
1.14	3-Way Key fixed in bakelite with brass terminals	1	100
1.15	Reversing switch: Switch frame double sided, external connection provision for reversing, silver contact, phosphor bronze blades operated by insulated lever, six terminals to connect external loads 5A/10 amp	1	300
1.16	Earth tester: 500 volt, 0.10-100 ohms with 3/4 terminals, complete with all accessories (hammers, screw driver, 3 spikes with connecting leads, as per ISS) Accuracy $\pm 1\%$ FSD, housed in teak wood/ebonite case, with leather case	2	10,000

Sr No	Particulars	Qty.	Cost in Rupees
1.17	Moving Iron Voltmeter/Ammeter: Portable moving iron measuring Instrument, housed in teak wood/ebonite case, scale 150 mm knife edge pointer, with anti mirror, critically damped, accuracy 1% FSD		
	a) 0-500 mA-1000 mA	2	2,000
	b) 0-5-10 amp	8	8,000
	c) 0-2 amp	1	1,000
	d) 0-125-250 volts	5	5,000
	e) 0-250-500 volts	4	4,000
1.18	Wattmeter: Portable dynamometer type, housed in teak wood/ebonite case, scale 150 mm knife edge pointer with anti parallax, current range 0-5-10 amp Voltage range 0-250-500 volt or 125-250 volt	3	7500
1.19	Rheostats: Sliding Rheostats wound with evenly oxidised iron free nickel copper on vitreous enamelled round steel tube. Contactors should be made of laminated phosphor bronze sheet. Resistance tolerances $\pm 2\%$		
	a) Single tube 150 ohm – 2 A	3	4,500
	b) Single tube 300 ohm – 5 A	3	5,000
	c) Double Tube 500 ohms – 20 A, 30 A	3	6,000
	d) Double Tube 440 ohms – 3 A	3	6,000
	e) Double Tube 110 ohms – 10 A	3	6,000
1.20	Dimmerstat: Single phase 0-230 V, output 0-270 V, 10A	2	5,000
1.21	Inductance: Coil mounted provision for change in value, well polished teak board with terminals fitted with 2.5 Kg variable core	3	7,500
1.22	Variable Inductor: Single phase, 250 V, mounted on well polished teak wood frame with terminals, 2.5 kW, continuously variable core type.	1	2,000
1.23	Energy meters:		
	a) single phase, induction type, 50 Hz, 5A/10A, 250 V, accuracy $\pm 1\%$	3	1500
	b) 3 phase, Induction type, 4 wire, 440 V, 20-40A, 50 Hz, accuracy $\pm 1\%$	3	3000
1.24	Sub standard energy meter		
	a) single phase, Induction type 50 Hz, 5A/10A 250 V	1	3,000
	b) 3 phase, Induction type, 4 wire. 440 V 10 A, 50 Hz.	1	5,000
1.25	Phase Regulator: 10A, 250V, 2.5 KVA variable power factor and lagging to leading arrangement indicator	1	5,000

Sr No	Particulars	Qty.	Cost in Rupees
1.26	Power Factor Meter: Dynamometer type, eddy current type damping, frequency 50Hz, scale length 150mm, current range upto 20 amp, voltage range 300 volts, PF range 0.5 lag, unity, 0.5 lead, Wood/ebonite, with antiparallax mirror, knife edge pointer.	1	2500
1.27	Load: 3 phase variable resistive load, 415 V, 10 KW, trolley mounted tube type provided with switches to vary the load in twenty steps,	2	10,000
	Continuously variable inductive load, 415 V, 10 kW terminal for end connections	1	4,000
1.28	LCR/Q Bridge: Capable of measuring resistance inductive and capacitance of range, 8 amps. 0.012 to 10 Mega ohm, 4 to 10000 H, 0.5 pico farad to 10 F Direct reading of the factor from 0.15	1	4,000
1.29	Frequency meter:		
	a) Digital, 4 digit LED display frequency meter suitable for use on 230 V AC main supply range 20-99 Hz	1	1500
	b) Vibrating Reed type 230 V, having 21 reed 40-60 Hz. abs Body	1	1,000
	c) Moving Coil type, portable housed in phenolic moulded body with antiparallax mirror. Scale and knife edge pointer, range 40-60 Hz, 230 V	1	1500
1.30	Phase sequence indicator: Portable, housed in a plastic moulded casing, rotating disc type, supported with one meter long red, yellow and blue leads with clips, rating 30 sec. 500 V, burden 15 VA voltage 50 to 500 V (Horizontal) frequency 25 to 50 Hz.	1	500
1.31	Max. Demand Indicator: Suitable for 3 phase 4 wire 3x230 V ac 50 Hz unbalanced Load, C.T operated 100/5 A with integrated time 30 minutes as per ISS 72.2	1	7000
1.32	Flux meter: Operated on 230 V ac portable with selector switch, output, 10 mV on all ranges 0-50, 0-100, 0-200, 0-500, 0-1K, 0-2K, 0-10K gauss. Accuracy $\pm 1\%$ with built in calibration	1	3,000
1.33	Thevenin Theorem Module: complete with accessories and the measuring instrument, operated by 6 volt dc supply	1	2,500
1.34	Norton theorem Module: Complete with accessories and measuring instruments operated by 6 volt dc supply	1	2,500
1.35	Maximum Power transfer theorem module complete with accessories and measuring instruments operated by 6 volt dc supply	1	2,500

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1.36	AD trains formulation: Module complete with accessories and measuring instruments, operated at 6 volt dc supply	1	1,500
1.37	Schering Bridge: Operated on 6 volt dc. supply complete with accessories built to measure directly value of capacity and loss angle.	1	2,000
1.38	Cathode Ray Oscilloscope 10 MHz Vertical deflection Bandwidth DC-10 MHz(-3db) Rise time 30 ms, Deflection coefficient 12 calibrated steps, 5 mV/cm to 20 V in input impedance 1 M ohm started by 25 p.f input coupling DC-AC-GND Max. input voltage-500 V(DC+ peak AC)	1	17,000
1.39	Horizontal Deflection: Bandwidth 1Hz to 1 MHz (+6 dB); Test voltage of 1.6 V, test current 28 mA, est Frequency, 50 Hz.		15000
1.40	Transformer: Single phase, core type, natural air cooled, 230/110 V, 1 KVA, 50Hz	1	2,000
1.41	Shunt: 0-75 A	1	200
2	ELECTRICAL MACHINES LABORATORY		
2.1	Static Converter: 3-Phase, 415 V, 50 Hz, output 230 V dc 15 KW, regulation + 1%, servo controlled, thyristorised	1	30,000
2.2	DC Shunt Motor - Shunt Gen. Set: DC shunt motor 230 V, 3 kW, 1440 rpm coupled with DC shunt generator, 230 V, 3kW, complete with appropriate panel board with meters, switches, indicators starter and field regulator	1	30,000
2.3	DC Shunt Motor - Series Gen. Set: DC shunt motor 230 V, 3 kw, 1440 rpm combined with DC series generator, 230 V, 3kw, complete with appropriate panel board, starter and field regulator	1	30,000
2.4	DC Compound motor Gen. set.: DC shunt motor 230 V, 3 kW, 1440 rpm coupled with DC compound generator, 230V, 3kw, complete with appropriate panel board, starter and field regulator	1	30,000
2.5	DC Compound Motor: Motor with interpoles 230 V, 3 kW, 1440 rpm with field regulator, starter and braking(eddy current or drum pulley) arrangement with appropriate panel board	1	20,000

Sr No	Particulars	Qty.	Cost in Rupees
2.6	DC Series motor: DC series motor with interpole/compensating winding, 230 V, kw, 1440 rpm with breaking (eddy current or drum pulley) arrangement and appropriate panel board and over speed safety precautions e.g. light shunt winding etc.	1	8,000
2.7	DC Motor-alternator set: DC shunt motor 230 V, 3 kw, 1440 rpm coupled with 3 phase 440 V, 50 Hz alternator having damper winding with exciter complete with appropriate panel board, starter and field regulators	2	25,000
2.8	Squirrel Cage Induction Motor: 3-phase squirrel cage induction motor 3 Kw, 415 V, 50 Hz, 1440 rpm all six terminals brought out, complete with appropriate panel board, starter etc.	1	6,000
2.9	Slip ring Induction motor: Three-phase, wound rotor induction motor, 3Kw, 415 V. 50 Hz, 1440 rpm with stator and rotor terminals brought out coupled with a dc shunt generator, 230V, 3 KVV with appropriate panel board and starter	1	20,000
2.10	Pole Changing/Winding Study Motor: Three phase double speed, 440V. 50 Hz, 1-3 Kw induction motor with all the coil terminals brought out for connecting winding for different speeds	1	6,000
2.11	Single phase Induction Motor(various types):		
	a) Capacitor start with centrifugal switch 0.5 KW with suitable loading arrangement and appropriate panel board.	1	3,000
	b) Shaded pole type,0.5 KVV,230 V,50 Hz with suitable loading arrangement and appropriate panel board	1	3,000
2.12	Universal motor: 230V, 50 Hz, Universal motor, 0.5 KW	1	2,000
2.13	Hysteresis motor: 230V, 50 Hz, Hysteresis motor, 0.5 KW	1	2,000
2.14	Servo motor: 230V, 50 Hz, Servo motor	1	10,000
2.15	AC commutator motor: 230V, 50 Hz, ac (Repulsion type) commutator motor 0.5 KW with suitable loading arrangement	1	2,000
2.16	1-phase transformer: Single phase transformer, 230/115 V, 50 Hz, 3 KVA housed in a metal tank	4	12,000
2.17	3-Phase transformer: Three phase transformer, 415/230V,50 Hz, 5 KVA all terminals brought out, housed in a metal tank	2	15,000

Sr No	Particulars	Qty.	Cost in Rupees
2.18	Scot-connection Transformer: Single phase transformer, 230/115V, 50 Hz, with tapping at 86%, 50% housed in a metal tank and all terminal brought out	2	5,000
2.19	Variacs:		
	a) One phase, 230 V, 50 Hz, 8-A auto transformer continuously valuable, housed in a metal body, portable	3	6,000
	b) One phase, 230 V, 50 Hz, 15-A transformer continuously valuable, housed in a metal body, portable	2	7,000
	c) Three phase, 230 V, 50 Hz, 30 A, 415-V transformer continuously valuable housed in a metal body, portable phase	3	30,000
2.20	Loading Rheostats:		
	a) Resistance type, single phase, 230V, 15A, each natural air cooled, housed in metal body fitted with switches and mounted on trolleys	3	12,000
	b) Resistance type, three phase 440V, 15A, natural air cooled, housed in metal body, switches and base wheels, six terminals brought out	1	6,000
	c) Continuously variable choke type loading coil, coil upto 15A, three phase, 440V, 50Hz, housed in a metal case on wheels (Trolley Aid)	2	6,000
	d) Capacitor bank, variable in steps through switches, 440V, 3 phase, 15A max. housed in a portable metal case	1	6,000
2.21	AC motor Starters		
	a) DOL starter, suitable for 415V, 3 Phase, 50 Hz, 3kw induction motor	1	2,000
	b) Auto transformer starter for 3 phase, 415 V, 50 Hz, 5 Kw induction motor with facility of tappings	1	3,000
	c) Star-delta starter suitable for 415V, 3 Phase, 50 Hz, 5 kw induction motor		
	(i) Manual	1	3,000
	(ii) Automatic	1	3,000
2.22	DC Motor starters:		
	a) DC shunt motor starter, three point suitable for 230V, 3 kw motor	1	3,000
	b) -Do- 4 point	1	3,000
2.23	Rheostats: Wire wound Rheostats (Approx. of following rating)		
	440 Ohm, 3A	15	4500
	110 Ohm 8A	10	3,000

Sr No	Particulars	Qty.	Cost in Rupees
2.24	Tachometer: Digital non-contact type tachometers 0-10,000 rpm, 3 1/2 digit	4	8,000
2.25	Stroboscope: with calibrated dial for frequency/rpm measurement	1	2,500
2.26	DC Ammeters: Portable moving coil permanent magnet 150 mm uniform scale with anti parallax mirror, knife edge, pointer, housed in a teak wood/ebonite case, accuracy + 1-5%		
	a) Ammeter 0-3 amp	6	3,000
	b) Ammeter 0-25 amp	6	3,000
	c) Ammeter 0-50A	6	3,000
2.27	DC Voltmeters Portable moving coil permanent magnet 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in a teak wood/ebonite case, accuracy \pm 1-5%		
	a) 0-15	4	3,000
	b) 0-50	2	1,500
	c) 0-150	3	2,250
	d) 0-300	10	7,000
	e) 0-600	1	700
2.28	AC Ammeters Portable moving iron, 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in a teak wood/ebonite case, accuracy \pm 1.5%		
	a) 0-1A	3	3,000
	b) 0-3A	3	3,000
	c) 0-10A	7	8,000
	d) 0-20A	7	5,000
2.29	AC Voltmeters Portable moving iron 150 mm uniform scale with anti parallax mirror, knife edge pointer, housed in a teak wood/ebonite case, accuracy \pm 1.5%		
	a) 0-1V	3	2,000
	b) 0-15V	3	2,000
	c) 0-30/60 V	4	3,000
	d) 0-150/300 V	10	7,000
2.30	Multimeter:		
	a) Digital/type: 3 1/2 digit LCD display manually operated multimeters with AC/DC 10 A and 10 mega ohm, accuracy \pm 0.5% for DC and \pm 1% for AC	2	2,500
	b) Indicating type DC voltage: Sensitivity 10 k ohm/v range -300 kV, 1, 3, 10, 30, 100, 300, 1000V; AC voltage - sensitivity 10 K ohm/V Range 1,3,10, 30, 100,300,1000V etc.	2	2,000

Sr No	Particulars	Qty.	Cost in Rupees
2.31	Wattmeters: Portable dynamometer type: Portable dynamometer measuring instrument housed in a teak wood/ebonite case scale 150 mm, knife edge pointer with antiparallax mirror, critically damped, accuracy $\pm 1\%$		
	a) 75/300/600 V and 1.5/3A (LPF)	2	4,000
	b) 75/300/600 V and 1.5/20A (UPF)	2	4,000
	c) 75/150/300 V and 15/30A	4	8,000
	d) 110/220/440 V and 15/30A	4	8,000
2.32	Portable Power factor meters: Dynamometer type, eddy current type, damping, frequency cycle 50 Hz, scale length 150 mm, current rated upto 20A, Volt-300V. p.f. range 0.5 lag-unity 0.5 lead, housed in teak wood/ebonite case with antiparallax mirror with knife edge pointer		
	a) Portable type single phase single element type 110 V/240 V or 1 A or 5 A	1	2,500
	b) Portable type 3-phase single element type 110 V/ 240 V, 1 A or 5 A	1	2,500
2.33	Frequency Meter:		
	a) Pointer type Portable type housed in phenolic moulded body with antiparallax mirror scale knife, edge pointers range 40-60 Hz, 230 V, 110 V or 240 V or 45-55 Hz	1	1500
	b) Read type 230 V, range 40-60 Hz and 21 Read	1	1500
	a) Digital type. 3 1/2 digit: LED, display frequency meter suitable for use on 230V AC main supply range 20-99Hz	1	1,000
2.34	Synchroscope: Suitable for 110V AC, 1-phase, 50 Hz alongwith potential transformer, 230V and 415V on primary and 110V on secondary side	1	2,500
2.35	Phase Shifting Indicator: Suitable for 50 V to 500 AC from 25 Hz to 55 Hz	2	6,000
2.36	Tong Testing Ammeter: 0-15 A/50A/100A Clip-on type	1	3,000
2.37	Current Transformer: 100-50-25-10/5A	2	1,000
2.38	Potential Transformer:		
	a) 10 VA, 440/110 V	1	1,000
	b) 10 VA, 220/110 V	1	1,000
2.39	DC Regulated Power Supplies: 0-30V, 5A, DC and also with short circuit and over load protection with measuring devices	2	4,000
2.40	Controllers, Timers, Contactors and limit switches		4,000

Sr No	Particulars	Qty.	Cost in Rupees
2.41	Equipment for additional experiments: 3-phase Brushless alternator coupled to dc shunt motor may be added 8KVA,415volts,3-phase,50Hz,1500rpm	1	20,000
2.42	Rectifier-Inverter Set: 3-Phase, 3KVA, 415V, 50Hz on rectifier input side 3 phase, 3 KVA,25 to 150 Hz on the output side	1	10,000

NOTE:

It is recommended to introduce universal machines in as many numbers as possible from the point of view of modernization of the machine laboratory for setting up of the same experiment for the complete group as well as from the point of view of teaching machines from the unified theory of machines. However, the choice is left to the individual polytechnics to have flexibility in this regard

3. ELECTRICAL WORKSHOP

3.1	Coil Winding Machine: Bench mounted, power driven with clutch and brake built into winding head, electromagnetic traverse clutch system for setting winding length of wire range .05 to 1.5 mm dia. Max. winding speed 250 to 5500 rpm speeds, coil dimensions Max. dia 150 mm, electric motor 0.5 HP, 1725 rpm, 230 V AC single phase, 50 Hz with essential spare	1	10,000
3.2	Bench Drilling Machine: Drilling capacity 13 mm, slotted and adjustable drilling, Table size 250 x 250 mm app. Belt driven with 4 speed ranges from 50 to 2000 rpm, electric motor power 0.5 kw. suitable for an electrical supply of 240 V AC single phase 50 Hz	1	5,000
3.3	Portable Drilling Machine: Hand electric drill machine with speed control having specification Drilling 10 mm, no load speed 700 rpm ,435 W capacity, Supply voltage 230 V, 50Hz supply	3	3,000
3.4	Multi meter: Laboratory service type with large and easy to read mirror scale with over head protection high accuracy, voltage range a.c/ d.c 0-600 V Current Ranges - AC 50 mA - 10 amp. DC 10 mA - 10 amp Ohmmeter 2 Ohm to 20 K Ohm Accuracy DC voltage and current $\pm 1\%$ AC voltage and current $\pm 2\%$, Ohmmeter $\pm 3\%$ with test leads and carrying case	2	3,000
3.5	Meggar: Insulation tester having hand driven generator to generate 500 volts DC having effective range of measuring insulation resistance from 0 to 100 M ohm. Confirming to IS 2992/1965	2	6,000

Sr No	Particulars	Qty.	Cost in Rupees
3.6	Fans of various type with one having solid State speed regulator:		
	a) Ceiling fan: 1200 mm, 1500 mm sweep operating at 230V, 50Hz, supply AC	1	1,000
	b) Table fan: 400 mm sweep operating at 230 V, 50 Hz, supply AC	1	1,000
	c) Exhaust fan: 375 mm sweep operating at 230 V, 50 Hz, supply AC main 0.25 HP	1	2,000
	d) Desert cooler, complete with 375 mm sweep, 1400 rpm, 1/4 HP motor operating at 230 V, 50 Hz, AC, complete supporting frame fan, water circulating pump, float and control switches etc.	1	5,000
3.7	Electrical Appliances:		
	1. Electric Kettle: 750 watts, 230V single phase AC, 50Hz, capacity 1 lit.		
	a) Filament type	3	2,000
	b) Rod type rated 1000 watt.	3	2,400
	2. a) Electric Iron, 500 watt, 230 V, Ordinary, 50 Hz, 1 Kg weight	6	1,800
	b) Electric Iron, 500 watt, 230 V, Automatic, 50 Hz, 1/2 Kg	6	3,000
	3. Electric Toaster: 500 watt	1	800
	4. Geyser 15 lit capacity, 2 Kw, 230 Volts 50 Hz, AC	2	6,000
	5. Immersion rod: 1000 watt, 230 Volts 50Hz, AC supply operated	12	3,600
	6. Room Heater 1000 watt, 230 V, 50 Hz, AC supply		
	a) Parabolic type	6	2,400
	b) Rod type (single rod/double rod)	6	2,400
	7. Air convector: 1000 watts, 230 V, 50 Hz, with 2 temperature settings	2	3,000
	8. Mixer cum grinder: 250 watts, 230 volts, 50 Hz, 1 1/2 lit. capacity with various attachments (food processor)	1	3,000
	9. Heater: Wire wound type, 1000 watts, 230 V, 50 Hz supply	6	3,000
	10. Hot plate: Single/double filament 1500/2000 watts, with control knobs operating at 230 V, 50 Hz, AC supply	4	4,000
	11. Electrical Oven: 2 KW, with temperature control devices and temperature indicating meters operating at 230 volts, 50 Hz AC supply	1	2,000

Sr No	Particulars	Qty.	Cost in Rupees
12.	Refrigerator 165 litres	2	14,000
13.	a) Washing Machine: 0.5 HP washing machine to be operated at 230 V 50 Hz, AC 20 lit. cap. round tank type	1	2,500
	b) Washing Machine: 0.5 HP washing machine to be operated at 230 V 50 Hz, AC 6.5 lit. semi-automatic	1	4,000
14.	Electric Shaver: 40-60 watts, to be operated at 230 V, 50 HP supply	1	1,000
15.	Electric Lighter: to be operated at 230 v, 50 Hz Electric/Electronic	1	200
3.8	Armature Growler: Armature testing growler suitable for finding faults in armature like open circuit, short circuit, ground fault, turn to turn fault and shorted commutator etc. Suitable to work on 230V 50 Hz ac supply, Growler should be provided with testing probs and meters to indicate faults	1	2,000
3.9	Digital clip-on meter: Digital Clip-on meter with following specifications: i) Display 3.5 digits ii) Max. reading 1999 iii) AC current Resolution Accuracy Range 200 Amps to 100 mA ± 1.25 to 5 digit 100 Amps to Amp iv) AC Voltage 2000 V to 0.1 V : $\pm 1\%$ to 5 digit 1000 V to 0.1 V : $\pm 1\%$ to 5 digit v) Resistance 200 MOhms to 0.1 ohms $\pm 1.00\%$ Instruments should be provided, with test leads and carrying case	3	3,000
3.10	Electric Blower: for cleaning equipment, powerful light weight with flexible hose 2 mtrs long complete with mains cable, standard Accessories i.e. Suction arrangement, hot air attachment, spray attachment suitable for an electric supply of 230 V 50Hz AC	1	6,000
3.11	Miniature Circuit Breakers(MCBs)		1200
	a) 16, 40 and 60 amps in single phase	6 each	1,800
	b) 100 amps 3 phase	6 each	1,200
	c) 200 amps 3 phase	6 each	1,800
3.12	Oil Testing Set: Oil testing set as per ISI 6792/1972 input voltage 220-250 volt, 50 Hz AC Output voltage 0-50 kv, accuracy $\pm 4\%$ of FSD Rate of rise of voltage automatic 2 Kv/Sec motorised.	1	10,000

Sr No	Particulars	Qty.	Cost in Rupees
3.13	Electric Lamps:		
	a) Mercury vapour lamp 120 watt, 230v, 50 Hz AC supply complete with choke, lamp holder and power factor capacitor	2	5,000
	b) Mercury vapour lamp ML type 120/125 watt, 230 v, 50 Hz supply	2	4000
	c) Sodium vapour lamp 120 watt/250 watt, 230 volts, 50 Hz with choke	4	8,000
	d) Fluorescent tube: 20/40 watt, 230 V, 50 Hz, single phase with choke, starter and fittings various sizes and types i.e. round etc.	2	400
	e) Halogen lamps: 1000 watts/1500 watt, 230 v, 50 Hz complete with fittings (Fluorescent tube light)	1	300
	f) Filament Lamps		
	- 60 W lamp, 230 V	100	1,000
	- 60 W lamp, 100 V	100	1,000
	- 60 W lamp, 230 V	100	1,000
	- 200 W lamp	100	1,500
	- 500 W lamp	100	1,500
	- 100 W – 110 V lamp	100	1,500
	- 100 W - 150 V lamp	100	1,500
	g) CFL LAMP	50	7,500
3.14	Emergency Light:		
	a) 55 cm long, with 6 volts battery suitable for vertical and horizontal position	1	500
	b) (Fluorescent tube light) portable type twin tube 1"(25.4 mm) long with 6 volts battery for vertical and horizontal position	1	500
3.15	Voltage Stabilizer: 500 VA, input 170/260 volts, output 210- 240 volts automatic with voltmeter	2	2,000
3.16	Bridge Insulation Tester: Transistorized battery operated bridge insulation tester battery operated push button indications built in wheat stone bridge Varley and Murray loop facilities for finding cable faults bridge suitable for 0.01 m to 11 m available in length of 200-1000 meters	1	5,000
3.17	Automobile Electrical Wiring Demonstration working model for automobile Electric wiring	2	6,000
3.18	Screw Driver Set: Electrician type round nickel plated steel blade, flat tip with plastic insulated handle following sizes: Blade Sizes	6 each	1,000
	i) 2.5 x 60 mm		
	ii) 3 x 80 mms		
	iii) 4 x 120 mm		
	iv) 5 x 160 mm		
	v) 5 x 200 mm		

Sr No	Particulars	Qty.	Cost in Rupees
3.19	Combination Pliers: 205 mm length with thick plastic insulated handle Insulated for 500 V (Taparia, PYE make)	8	2,500
3.20	Long Nose Pliers: 150 mm insulated for 500 volts	12	1,000
3.21	Diagonal Pliers: 150 mm insulated for 500 volts suitable for cutting hard wires	6	600
3.22	Adjustable Wrench Chromium plated adjustable wrench lengths 255 mm max. opening 30 mm	6	3,000
3.23	a) Flat nose pliers: Rectangular section jaw and smooth gripping surface plastic insulated handles length 130 mm	3 each	300
	b) Slip Nose Pliers with slim long grains of half round section and smooth gripping surfaces plastic insulated handle length 130 mm	6	300
	c) Round Nose Pliers: With slim long round grains and plastic insulated handles lengths 130 mm	3	300
3.24	Ball Pien Hammer: Ball pein hammer with polished fall and pein wooden handle having wts i) 250 gms ii) 500 gms iii) 800 gms	3 each	500
3.25	Screw Holding Screw Driver Set: Screw driver set fitted with spring each clips to secure screw head round or hexagonal chromium plated blade with plastic handle set of three screw driver blade size i) 4 x 50 mm ii) 4 x 75 mm iii) 4 x 100 mm	6	400
3.26	Instrument Makers Screw Driver Set: Set of screw drivers with chrome vanadium set steel shaft and fluted nickel plated steel handle with hexagonal end shaft width 0.8 to 3.8 mm complete with plastic case	2	300
3.27	Tweezers a) With blunt serrated Jaws stainless steel nickel plated length 160 mm b) Pointed ends serrated jaws stain less steel nickel plated length 130 mm	1 1	50 50

Sr No	Particulars	Qty.	Cost in Rupees
3.28	Work shop Scissors Stainless steel, scissors suitable for cutting insulation, paper, plastic etc. length approx. 150 mm	6	300
3.29	Adjustable Hacksaw Frame: Extra robust tubular steel frame cast handle adjustable for hacksaw blade from 250 - 300 mm with set of 10 spare blades	4	300
3.30	Hand Drill Machine: Two speed hand drill machine with enclosed gear adjustable crank, supporting handle, self centering chuck for straight shank drills upto 10 mm	6	900
3.31	Bench Vice: Drop forged steel bench vice with jaw width 100 mm, Jaw opening 120 mm, Jaw depth 75 mm, quick release complete with i) One pair of detachable aluminium protective jaw plates ii) One pair of detachable fibre protective jaw plates	2	800
3.32	Bearing Puller Three legs heavy duty bearing puller of size 100 mm/200 mm	1	400
3.33	Automatic Centre Punch: Spring loaded action knurled shank centre punch length 115 mm and dia at point 2mm	2	200
3.34	Wire Gauge: Suitable upto 0-76 SWG	1	200
3.35	Try Square: Engineers try square from stainless steel with stock 90 degrees all sides accurately finished legs 150 x 100 mm	2	100
3.36	Measuring tape: Pocket measuring tape of steel spring return device, flexible, clearly graduated in metric readings 2 mts long	6	200
3.37	Files Set: Hand files with plastic handles for each general metal treatment double cut 200/350 mm long consisting of i) Flat smooth cut ii) Flat second cut iii) Half round second cut iv) Half round smooth cut v) Round second cut vi) Round smooth cut vii) Square second cut viii) Square smooth cut ix) This single cut smooth 20 x 3.3mm x) Triangular file 200 mm	2	1,000

Sr No	Particulars	Qty.	Cost in Rupees
3.38	Wire Stripper: Stripper with side mounted spring return and adjustable jaws via lock screws for cable insulation maximum 4 mm dia length 150 mm.	2	100
3.39	Screw Driver Mains Voltage Tester: Flat tip screw driver with built in new test lamp transparent plastic handle insulated block, metal pocket clip suitable upto 400 v. AC blade 4 x 100 mm Overall length 180 mm	2	200
3.40	Cable Knife: Electrician knife blade made from stainless steel with length 50 mm plastic moulded handle overall length 180 mm	12	100
3.41	Soldering Gun Kit: Instant action soldering device trigger controlled with built in illumination of soldering butt bakelite housing, normal power 45 watts, with approx. 2 mts supply cord suitable for electric supply of 230 volt AC, single phase 50 Hz. Accessories: (i) Fine bit (ii) Bit for plastics	3	6,000
3.42	Rubber Mallet: Soft Rubber with wooden handle approx. 200 grms	6	300
3.43	Screw Extractor Set: Left hand thread for easy removal of broken right hand threaded screw and bolts. Set of three extractors for screws with die from 3 to 11 mm	3	300
	Figure Stamp Set for marking made from high grade stainless steel figure height 4mm complete with plastic box	2	200
3.44	Letter Stamp Set: Made from high grade steel, character set height 4 mm, full set of alphabets complete with plastic box	1	100
3.45	L - End Key Set:		
	a) Metric set of 10 wrenches from 1.5 to 10 mm complete with plastic wallet 4 set	1	200
	b) Imperial set of 7 wrenches from 1/16" to 1/4" complete with plastic set wallet	1	200
3.46	Box Spanner Set: Round shank in chrome vanadium steel Hexagonal socket plastic handle set of nine spanners sizes 3, 4, 5, 6, 7, 8, 10, 12 and 14 mm overall length 150 mm	2	800

Sr No	Particulars	Qty.	Cost in Rupees
3.47	Open Ended Spanner Set: Double ended chrome vanadium steel jaws, jaw angle 15° oval shank set of 8 spanners. Jaw width 4x5, 5x5, 6x7, 7x8, 9x10, 10x12, 12x14 mm	2	800
3.48	Soldering Iron: Soldering iron 35 watts, 65 W, 100 Watts operating at 230 V, 50 Hz supply	2	300
3.49	Oil Can: 0.75 lit capacity	2	100
3.50	Blow Lamp: 1 Pint kerosene oil capacity blow lamp	2	400
3.51	Hand Saw: Hand saw 10" (254) size 10 teeth per inch teak wood handle	6	300
3.52	Chisels: Former chisel made of carbon steel of size 6 mm x 15 mm	3	150
3.53	Wrench Set: Set of 5(3/8 to 1 inch) chrome vanadium sets steel, offset type, 12 points, accurately sizes capacity 3/8x7/16, 1/2x9/16, 5/8x1/16, 3/4x7/8 and 15/16x1 inch (in metric sizes)	2	1,000
3.54	Pipe Wrench: High tensile steel, drop forged, hardened and tempered app. cap. 6 to 50 mm dia	3	500
3.55	Tap Wrench Set: Set of 4, bar type, adjustable for general purpose, made of best quality steel, approx. cap. 1.5 to 25 mm square	6	1,500
3.56	Electric Pneumatic Drilling Hammer: Drill capacity, 5-22 mm in concrete, 5-10 mm in steel rated voltage 235 volts, 50 Hz, AC, full load input 450 watt, full load speed 650 rpm. Impact rate 3270 Blows/minute	1	5,000
3.57	Work Bench: Steel construction but with wooden bench top not less than 50 mm thick with two steel drawers both lockable approx. size 1200x600x850 mm solid construction	1	1,500
3.58	Fire Extinguisher: Multipurpose fire extinguishers, suitable for electric installation and petrol fire, app. cap. 10 kg. rechargeable includes wall bracket and 2 recharging kits	5	5,000
4.	RELAY LABORATORY		
4.1	Different types of relay: Inverse time over current relay (induction type): Suitable for operation for 5 amps with setting range 50-200% adjustable in seven equal steps of 25% Time setting 0-30 second at 10 times the current setting AC supply-240 V, 50 Hz	1	10,000

Sr No	Particulars	Qty.	Cost in Rupees
4.2	Earth Leakage Relay: Suitable for operation for 5 amp. with following setting range 10-40% adjustable in seven equal steps of 5%	1	10,000
4.3	Inverse Over Current Time Static Relay: Auxillary DC voltage 24V. Inverse time - at 10 times - 70 ms. Definite time - at 10 times- 60 m.s. Frequency 50 Hz \pm 3%. Operating current 5 amps. with seven equal current setting	1	10,000
4.4	Relay testing kit with following accessories 1) Current circuit 2) Voltage circuit 3) Timer circuit 4) Control circuit suitable for testing a) Over current b) AC voltage c) Earth leakage Input - 230 volts single phase 50 Hz Output - current output 1,2,5,10, 20A Maximum capacity 6 KVA Voltage output - 50 V, 110V fixed at 2 amps for timer starting capacity 2 amps. Time measurement with the aid of digital time internal meter 99.99 m.sec. 999.9 m.sec 9.9999 sec. 99.99 sec. 999.9 sec.	1	15,000
4.5	Oil circuit Breakers - IS 2516/1972; IS 116, IEC 56: Maximum oil type No. of Pole 3; Frequency - 50 Hz; Nominal system 33 KV of voltage; Highest system voltage 36KV; Interrupting; capacity 500 KVA; operating duty 0-3 min; Breaking time 5 cycles; Control elect. voltage 24 volts; continuous current rating 400 A; short time current rating 8.75 KA for 3 sec	1	50,000
4.6	Relay demonstration panels for (1) Generator protection (2) Transformer protection (3) Transmission line protection: Generation protection panel should include differential protection for (a) Stator winding (b) Earth leakage protection (c) Field failure protection Transformer protection panel should include the differential protection for Y-Y and Y- Δ connection of 3-phase transformer Transmission line protection panel should be provided with distance protection for 3 zones	1	1,00,000 25,000

Sr No	Particulars	Qty.	Cost in Rupees
4.7	Air Circuit Breaker: 600 amp, 3 pole, 660V, 50 Hz, Rated Breaking Cap. 35 KA to 40 KA AC Rated Making Cap. 73.5 KA to 40 KA DC Total operating time 0.03 sec. Draw out type metal clad construction: with Safety shutter position, short circuiting contact, insertion prevention device, Manual/Motor charging type, solid state type, Thermal magnet type, under voltage instant trip/ quick acting, suitable key lock	1	50,000

5. ELECTRONICS LABORATORY

List of equipment required for Electronics Laboratory(ies) can be obtained from the curriculum document for "Diploma Programme in Electronics and Communication Engineering" for the State of Haryana.

NOTE:

In addition to the above, laboratories in respect of physics, chemistry, applied mechanics, strength of materials, general engineering, workshops, Computer Centre etc will be required for effective implementation of the course. Provision for overhead projector, TV with VCR facility, slide cum strip projector, 16 mm film projector, photocopier, PC-XT facilities, duplicating machines, drafting machines etc has also to be made.

10.1.3 Furniture Requirement

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

10.2 Human Resources Development:

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

The Workshop group suggested following qualifications and experience for the teaching faculty and technical staff for implementing the diploma programme in Electrical Engineering.

Following are the qualifications and experience for the teaching faculty and technical staff

Qualification	Experience
<p><u>Lecturer</u></p> <p>First class B.E./B.Tech in Electrical Engineering or equivalent</p>	<p>NIL</p>
<p><u>Sr.Lecturer</u></p> <p>First class B.E./B.Tech in Electrical Engineering or equivalent</p>	<p>5 years experience in teaching/industry/research at the level of Lecturer or equivalent</p>
<p><u>Head of Department</u></p> <p>M.E./M.Tech in Electrical Engineering or equivalent with first class at Masters or Bachelor's level</p>	<p>5 years experience in teaching/industry/research at the level of Lecturer or equivalent</p>
<p><u>Note:</u></p> <p>Candidates from industry/profession with B.E/B.Tech in Electrical Engineering or equivalent and with recognized professional work experience equivalent to Master's degree and 5 years experience may also be eligible for the post of H.O.D.</p>	
<p>Technician</p> <p>Three years diploma in Electrical Engineering or equivalent</p>	<p>2 years practical experiences in teaching/industry/research at appropriate level</p>

11. EVALUATION STRATEGY

11.1 INTRODUCTION

Evaluation plays an important role in the teaching-learning process. The major objective of any teaching-learning endeavor is to ensure the quality of the product which can be assessed through learner's evaluation.

The purpose of student evaluation is to determine the extent to which the general and the specific objectives of curriculum have been achieved. Student evaluation is also important from the point of view of ascertaining the quality of instructional processes and to get feedback for curriculum improvement. It helps the teachers in determining the level of appropriateness of teaching experiences provided to learners to meet their individual and professional needs. Evaluation also helps in diagnosing learning difficulties of the students.

Evaluation is of two types: Formative and Summative (Internal and External Evaluation)

Formative Evaluation

It is an on-going evaluation process. Its purpose is to provide continuous and comprehensive feedback to students and teachers concerning teaching-learning process. It provides corrective steps to be taken to account for curricular as well as co-curricular aspects.

Summative Evaluation

It is carried out at the end of a unit of instruction like topic, subject, semester or year. The main purpose of summative evaluation is to measure achievement for assigning course grades, certification of students and ascertaining accountability of instructional process. The student evaluation has to be done in a comprehensive and systematic manner since any mistake or lacuna is likely to affect the future of students.

In the present educational scenario in India, where summative evaluation plays an important role in educational process, there is a need to improve the standard of summative evaluation with a view to bring validity and reliability in the end-term examination system for achieving objectivity and efficiency in evaluation.

11.2 STUDENTS' EVALUATION AREAS

The student evaluation is carried out for the following areas:

- Theory
- Practical Work (Laboratory, Workshop, Field Exercises)
- Project Work
- Professional Industrial Training

11.21 Theory

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems. The formative evaluation for theory subjects may be caused through sessional/class-tests, home-assignments, tutorial-work, seminars, and group discussions etc. For end-term evaluation of theory, the question paper may comprise of three sections.

Section-I

It should contain objective type items e.g. multiple choice, matching and completion type. Total weightage to Section-1 should be of the order of 20 percent of the total marks and no choice should be given in this section. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

Section-II

It should contain short answer/completion items. The weightage to this section should be of the order of 40 percent of the total marks. Again, no choice should be given in section-II

Section-III

It may contain two to three essay type questions. Total weightage to this section should be of the order of 40 percent of the total marks. Some built-in, internal choice of about 50 percent of the questions set, can be given in this section

Table II : Suggested Weightage to be given to different ability levels

Abilities	Weightage to be assigned
Knowledge	10-30 percent
Comprehension	40-60 percent
Application	20-30 percent
Higher than application i.e. Analysis, Synthesis and Evaluation	Upto 10 percent

11.22 Practical Work

Evaluation of students performance in practical work (Laboratory experiments, Workshop practicals/field exercises) aims at assessing students ability to apply or practice learnt concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpret and draw conclusions and work related attitudes. Formative and summative evaluation may comprise of weightages to performance on task, quality of product, general behaviour and it should be followed by viva-voce.

11.2.3 Project Work

The purpose of evaluation of project work is to assess students ability to apply, in an integrated manner, learnt knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The formative and summative evaluation may comprise of weightage to nature of project, quality of product, quality of report and quality of presentation followed by viva-voce.

11.2.4 Professional Industrial Training

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of materials, industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. The formative and summative evaluation may comprise of weightages to performance in testing, general behaviour, quality of report and presentation during viva-voce.

11.3 ASPECTS OF QUESTION PAPER SETTING

Validity and reliability are the most important considerations in the selection and construction of evaluation procedures. First and foremost are the evaluation tools to measure the specific outcomes for which they are intended to measure. Next in importance is reliability, and following that is a host of practical features that can be classified under the heading of usability.

For weightage of marks assigned to formative (internal) and summative (external) evaluation and duration of evaluation has been given in the study and evaluation scheme of the curriculum document. Teachers/Paper-setters/Examiners may use Manual for Students' Evaluation developed by National Institute of Technical Teachers' Training & Research, Sector-26, Chandigarh to bring objectivity in the evaluation system.

12. RECOMMENDATIONS FOR EFFECTIVE CURRICULUM IMPLEMENTATION

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives.

Polytechnic teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practicals, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practicals and field experiences. Teachers are also required to do all these activities within a stipulated period of 16 weeks which is made available to them. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of the plan effectively.

Following is the gist of suggestions for subject teachers to carry out T-L process effectively:

1. Teachers are required to prepare a course plan, taking into account departmental academic plan, number of weeks available, course to be taught, different learning experiences required to be developed etc.
2. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of content to be covered, learning material (transparencies, Video Films, Models etc.) for execution of a lesson plan. They may follow steps for preparing lesson plan e.g. drawing attention, state instructional objectives, help in recalling pre-requisite knowledge, deliver planned subject content, check desired learning outcome and reinforce learning etc.
3. Teachers are required to plan for expert lectures from field/industry. Necessary steps are to plan in advance, identify field experts, make correspondence to invite them, take necessary budgetary approval etc.
4. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The tutorial, assignment and seminar can be thought of as terminal outcome of library experiences.
5. Concept and content based field visits may be planned and executed for such content of course which otherwise is abstract in nature and no other requisite resources are readily available in institute to impart them effectively.
6. There is a dire need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning/activity learning/ experiential learning approach effectively. The development of lab instruction sheets for the course is a good beginning to provide lab experiences effectively.
7. Planning of progressive assessment encompasses periodical assessment in a semester, preparation of proper quality question paper, assessment of answer sheets immediately and giving constructive explicit feed back to every student. It has to be planned properly; otherwise the very purpose of the same is lost.

8. The co-curricular activities like camp, social gathering, study tour, hobby club , NCC, NSS, Library studies, Civil Defence and Disaster Management etc. may be used to develop generic skills like task management, problem solving, managing self, collaborating with others etc.
9. Wherever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time.
10. While imparting instructions, emphasis may be laid on the development of cognitive, psychomotor, reactive and interactive skills in the students.
11. Teachers may take working drawings from the industry/field and provide practices in reading these drawings.
12. Teachers may take initiative in establishing liaison with industries and field organizations for imparting field experiences to their students.
13. Students be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.
14. Students may be given relevant and well thought out minor and major project assignments, which are purposeful and develop practical skills. This will help students in developing creativity and confidence for their gainful employment (wage and self).
15. A Project bank may be developed by the concerned department of the polytechnics in consultation with related Industry, Research Institutes and other relevant field organizations in the state.