SYLLABUS FOR

ELECTRONIC MECHANIC

UNDER

CRAFTSMEN TRAINING SCHEME

&

APPRENTICESHIP TRAINING SCHEME

As approved by
GOVERNMENT OF INDIA

In consultation with
THE NATIONAL COUNCIL FOR
VOCATIONAL TRAINING

&

CENTRAL APPRENTICESHIP COUNCIL

Issued by
GOVERNMENT OF INDIA
MINISTRY OF LABOUR
DIRECTORATE GENERAL OF
EMPLOYMENT & TRAINING
NEW DELHI

2007

GENERAL INFORMATION

1.	Name of the trade	:	Electronic Mechanic Under CTS / ATS
2.	N.C.O. Code No.	:	852.20
3.	Duration of Craftsmen Training	:	2 Years
4.	Duration of Apprenticeship Training	:	3 years including 2 years of Basic Training.
5.	Entry Qualification	:	Passed 10th Class Examination under 10 + 2 system of education with Mathematics and Science or its equivalent
6.	Rebate for Ex-Craftsmen Trainees (For Apprenticeship)	:	Electronics Mechanic Course
7.	Ratio of Apprentice to worker	:	1 : 5

LIST OF MEMBERS ATTENDED TRADE COMMITTEE MEETING

Sl. No.	*Name*	*Office*	
1.	Sri M.S. Lingaiah, Director	CSTARI, Salt Lake, Kolkata	Chairman
2.	Sri Sankar Dey, Zonal Manager	ECIL, Kolkata	Member
3.	Sri S.B Choudhary, Manager EEI.	SNTI, Tata Steel, Jamshedpur	Member
4.	Mr. Ashok Bhattacharya, Addl. Director.	ERTL (E), Kolkata	Member
5.	Sri S. Chattopadhyay, Asst. Prof. & HOD, Electrical	NITTTR, Kolkata	Member
6.	Sri C.S. Roy, Faculty	CETE/Ronix, Kolkata	Member
7.	Mr. Asim Sarkar, Tech. Officer (CIC)	CDAC, Kolkata	Member
8.	Mr. P.N. Sanyal, Co-ordinator/ Faculty of Electronics & Telecom.	The George Telegraph Training Institute, Kolkata	Member
9.	Sh. R. Senthil Kumar, JDT	CSTARI, Kolkata	Member
10.	Sh. R. K. Pathak, DDT	ATI, Mumbai	Member
11.	Sh. M.M. Gera, DDT	CSTARI, Kolkata	Member
12.	Sh. T. Mukhopadhyay, DDT	CSTARI, Kolkata	Member
13.	Sh. S. Kumar, DDT	CSTARI, Kolkata	Member
14.	Sh. V. Babu, ADT	CSTARI, Kolkata	Member
15.	Sh. A. Chakraborty, ADT	CSTARI, Kolkata	Member
16.	Sh. M. Gunasekharan, T.O.	ATI-EPI, Hyderabad	Member
17.	Mrs. Sipra Das, T.O.	CSTARI, Kolkata	Member
18.	Mr. Mohan Singh, T.O.	CSTARI, Kolkata	Member
19.	Sri. Tarun Kanti Das, T.O.	RDAT, Kolkata	Member
20.	Sri. P.K. Bairagi, V.I.	ATI, Dasnagar.	Member

SYLLABUS FOR THE TRADE OF ELECTRONIC MECHANIC UNDER CTS & ATS

No. of Weeks	*Syllabus List*	*Theory*	*Practical*	*Equipment Requirments*	*Engineering Drawing*	*Workshop Calculation & Science*
1	2	3	4	5	6	7
1.	Know your Institute	(a) Organization of the Institute (b) Types of work, respostibility to be undertaken, incentives and future planning of profession. (c) Safety precautions to be observed in the trade oath during Theoretical periods and workshop hours/ Practical classes. (d) Elementary First Aid. (e) Earthing types and importance.	(a) Visit to the Institute. (b) Introduction with the Principal and other teaching staffs. (c) Demonstration of various systems of the "Trade" like Radio, T.V. Controls etc. (d) Care & Safe working habits, safety precautions to be demonstrated by the trainee.	Power supplies Switchgears. Fire extinguishers. First Aid Kit First Aid Chart Artificail Respiration Chart. Instrument boxes and Drawing materials.	What is Engineering Drawing? Importance, Free hand sketching of st. lines, rectangles, square, circles, polygons etc. Free hand sketching of tools. Reading of simple	Quadratic equation, simultaneous linear equation in two variables.

1	2	3	4	5	6	7
			(e) Elementary First Aid paractice, Artificial respiration practice.		drawings and concept of dimensions and dotted lines chain lines etc. Magnifying glass	
2.	Hand Tools	Identification specifications, uses and maintenance of hand tools	Demonstration & uses of trade hand tools - screw driver, plier, etc. Simple mechanical fixtures, types of screws, bolts, washers, clamps, rivets, taps, connectors. Simple fitting practice. Simple threading practice. Simple sheet metal works. Demonstration on pneumatic screw driver.	Students' tool Kits and workshop tools.	-do-	Fundamental amd derived units. Supplementary units. S.I. units of Electrical parameters. Standards — definition, types — primary and secondary standards, working standards. Standards of length, mass, time, current, voltage.

1	2	3	4	5	6	7
3.	Introduction to Electricity	Matter, molecule, atom, Bhor's theory concept only. Electrostatics, Coulombs's law, electric field, Potential, Potential difference, charge, Resistances, Ohm's law	Identification of conductors, Insulators, with specifications. Use S.W.G. Demonstration of different soldering iron. Practice of soldering & desoldering. Practice of simple series and parallel Ckts. & mixed. Verification of Ohm's Law.	S.W.G. Multimeter soldering iron. Temp. Controlled soldering station.		Srandards of resistance, Inductance, Capacitance, temperature, pressure. Newton's Law of motion, applications. Momentum. Simple problems
4. & 5.	Resistors	Classification of resistors with specifications & use. Construction of resistors. Colour code. Kirchhoff's Law and its application. Explanation and only use of Multimeter. Wheatstone bridge (Balance Condition)	Identification of resistors. Colour code practice. Use of Multimeter — measurment of voltage, current and resistance. Experiments on P.T.S. resistots, N.T.S resistors P.T.S. Thermistor resistors.	S.W.G. Multimeter Soldering iron, cells, Multimeter.	Reading of simple drawing, Free hand sketching of simple solids with dimensions. Free hand sketch of solids	Arithmatic and Geometric progression. Sum of n-terms, simple calculations.

1	2	3	4	5	6	7
			P.T.C.L.C.R. resistor. Tests on and use of classified resistors. Carbon (Various W, W/W, PCT (Log & Linear) Pre-set etc. VDR LDR		viewed perpendicu-larly to their surface and axes.	
6.	Battery	Explanation of cells, Leclanche's cells, Primary cells, Secondary Cells, Battery construction charging rate. Efficiency Amp. hr capacity. Types of charging - Silver oxide L.C.R. button cells. Alkali-cells. Construction charging efficiency use, advantages	Testing of primary and secodary cells. Uses of cells and battery in ckts. Preparation of Electrolyte. Preparation of charging by a charger. Use of Sp. gr. tube / hydrometer.	Assorted cells and batteries. Assorrted rheostat, Hydrometer. Battery charger, Cells Tester	-DO-	Force — definition, units and frictional forces. Problems on force and frictional forces. Static and dynamic friction. Gravitational forces.
7.	Electro-Magnetism	Explanation of magnetism. Classification of	Demonstration on the properties of P.M., Use of	Assorted Pre-magnets. Magnetic	Free hand sketches of nuts with	Complex nos. Simple problems

1	2	3	4	5	6	7
		magnets and their materials. Properties of magnets. Uses and prepartion of artificial magnets. Magnetic needle. Magnetic keepers. Explanation of Electro-magnetism. Properties, advantages, application. Types of cores. E.M. relays— types uses.	magnetic needle. Simple practice of converting magnetic material into a magnet by a bar magnet. Preparation of solenoid. Use of magnetic needle. Preparation of electromagnets for a calling bell/ buzzer. Preparation of E.M. relay. Testing of types of relays	Needles. Assorted Bells & Bussers, Assorted relays.	dimensions from sample. Ckts and wiring diagram.	
8.	A.C. Funda-mentals	Explanation of A.C. comparison with D.C. Explanation of Induction & induced E.M.F., Faraday's Law, Lenz's Law. Generation of A.C. Sinusoidal nature of A.C. R.M.S. value,	Demonstration of A.C. & D.C. Demostration on Induced E.M.F. Demostration on L.H. & R.H. Rules. Demonstration on Instantaneous values and R.M.S. values.	Oscilloscope A.C. Auto/var. Models on L.H. & R.M. rules. Low frequency oscillator Multimeter 'f' counter.	-do-	Work, power and energy — definition, units and simple problems on shop floor

1	2	3	4	5	6	7
		average value, from factor, Peak value, Phase Sequence.	Demonstration on phase cycle, 'f' Measurement of A.C. voltages and current.			practices. Conservation of momentum and energy
9.	Inductance & Capacitance	Induction Explanation of inductive reactance, types, specification. Behaviour with A.C. & D.C. Explanation of Capacitance & capacitive reactance. Classification of capacitors with specification, Electrostatic action dielectric constant, material used. Series & parallel connection. Colour of capacitor, behaviour with A.C. & D.C. Time constant.	Identification of Inductors, Reactance's checking, testing & rewinding up to a specification. Impedance & P.F. measurements. Demonstration on self and mutual induction. Identification and testing of different types of capacitors. Colour code practice. Behaviour of capacitor at different frequencies	Oscilloscope A.C. Auto/var. Models on L.H. & R.M. rules. Low frequency oscillator Multimeter 'f' counter. Bridges - RLC or Digital Multimeter. Power supply, Oscillator, E.V.M.	Expl. of simple orthographic projection 1st angle	-do-
10.	A.C. circuits & Poly-phase ckts.	Reactance & impedance of R -L -C ckt. Series & parallel. Current voltage	Determination of resonance. Characteristics for	Oscilloscope, signal generator E. V. M.	Expl. of simple orthographic	Trigonometry - Identity & solve.

1	2	3	4	5	6	7
		distribution (simple problem). Resonance in RLC (series & parallel) acceptor & rejecter ckt. Q factor. Natural resonance & importance. Poly-phase (3ϕ) systems Star & Delta connection (Balance condition). Advantage of poly phase system.	series and parallel. tuning to a given 'f'.		projection 3rd angle.	
11 & 12.	D. C. 12. Machine	Construction and working principle of Generator & Motor, E.M.F. equation of generator & motor. Different types of Generator & Motor. Characteristics of D. C. Machine. Different methods of speed contro of D. C. motor. Uses of Motor.	Demonstration in different types of motor & study of speed control.	D. C. Motors, series, shunt. Electronic starters.	Expl. of simple orthographic projection 3rd angle.	Moment of inertia of simple shapes like ring, disc, cylinder & sphere.

1	2	3	4	5	6	7
13 & 14.	A. C. Machine	Construction and working principle of 1ϕ Transformer. Different types of 1ϕ Transformer. Efficiency and voltage regulation, open ckt. Test, short ckt. Test of 1ϕ Transformer, Eddy currect Hysteresis, turns ratio, type of core used for L.F., H.F. & V.H.F. Transformer. Basic idea of 3ϕ Transformer. Construction and working principle of 1ϕ Induction motor. Method of starting split phase & shaded pole motor. Explanation of principle of 3ϕ motor	Identification of assorted transformers - testing and rewinding up-to a specification. Identification, testing & running of 1ϕ motors. – Do – 3ϕ motors.	Capacitor motor. Electric Fan, Grinder, 1ϕ Transformer.	Expl. of simple orthographic projection 3rd angle	Logarithm definition, Properties, simple problems.
15.	Analog Meter	Introduction of Analog meter. Importance of Meter. Classification of meter. Forces neccesary to work a meter. M.C. Instruments. M.I.	Demonstration on the function of M.C. & M.I. meters. Measurement of resistance, voltage,	Assorted analog meters. multimeter, Models/Kits for assorted ckts.	Familiarizing and sketching the details of components.	Angular momentum & torque simple problems

1	2	3	4	5	6	7
		Instruments. Universal Instruments. Range Extension of meters. Need of calibration. Multimeter. Characteristics of meter. Use of meters in different ckt. Use of Multimeter. Servicing, care & maintenance. Use of Insulation tester.	current frequency, etc. by Ammeter Voltmeter, Ohmmeter, frequency meter. Use of Multimeter. Servicing of Multimeter. Demonstration on calibration of meters. Demonstration on Insulation tester.	Shunt & series resistors, standard meters.		
16.	Semi - conductor Theory	Energy band theory of crystals, Difference between conductor, insulators & semiconductors. Intrinsic & Extrinsic semiconductors. Common semiconductor materials. P - type, N - type semiconductors. Temperature effect. Formation of P & N type semiconductor. Formation of P - N Junction. Barrier	Demonstration on Barrier potential for Ge & Si.	Video films on Semiconductor, P. N. Junction. Digital Multimeter.	Familiarizing and sketching the details of components.	Areas of rectangle circles, regular Polygons, calculation of areas, volumes & weight of simple solids - Cubes, hexagonal Prisms. Shop problems.

1	2	3	4	5	6	7
		potential. Forward bias, Reverse bias operation & characteristics.				
17 & 18.	Semi - conductor Diode	Diode symbol & equivalent ckt. Diode characteristics. Static & dynamic resistance of diode, Ideal diode, Different type of diodes & working principle of Zener diode, Tunnel diode, Varactor diode, Schotty diode, LED. Zener Diode operation, Characteristics & equivalent ckt. Simple voltage stabilizer ckts. Using of Zener diode. Specification of diode	Testing of Diode. Characteristics of Diode. Characteristics of Diode & Zener Diode. Simple voltage stabilizer using Zever diode.	Multimeter, E.V.M. Oscilioscope.	Use of drawing instruments, 'T' square, drawing board construction of simple figures & solids with dimensions. Use of different types of scales in inch & millimeters. Lettering numbers & alphabets.	Concepts of elasticity & Elastic limits, Stress & strength. Hooke's Law, Young Modulus of elasticity, Application in Plant.
19.	Rectifier & Filters	Half wave, Full wave rectifiers (Center tap & Bridge). Voltage	Half wave, Full wave, Bridge rectifier ckts. Demonstration on various filters	Multimeter, Oscilloscope, Function Generator.	– do–	Simple problems on stress in bars. Concept of

1	2	3	4	5	6	7
		doublers, Tripler's & quadruplers. C, LC, Π filter of rectifiers, R.M.S voltage, Ripple factors, Utilization factors, percentage of regulation. What is filter ckt? Basic idea of passive and active filter. Characteristic equation and nature of curve of passive filter. *i.e.*, Low pass, high pass, band pass & Band stop filter, Saw filter. D.C. regulated and unregulated power supply using Zener diode.	ckts. Assembly, testing of L, T, Π Filters. Demenstration on H.P., L.P., B.P. filter circuits.	Trainer kits of Passive H.P, L.P, B.P. Filters (T/Π)		share Modulus, Bulk modulus & Poisson's Ratio.
20 & 21.	Transistor & Transistor biasing	Transistor action & characteristics of CB, CE & CC. And comparison of them. Symbol, Basic Transistor biasing. transistor as an	Identification and testing of a Transistor. To study α, β of a Transistor Characteristics of a Transistor (static and dynamic). To study		Drawing of various electrical ckts. with B.I.S. symbols of	Concepts of shear Forces, bending Moment, Torsion in shaft, Simple problems.

1	2	3	4	5	6	7
		Amplifier (simple form). D.C. load line, Different type of biasing methods of Transistor. *i.e.*, Fixed bias, Emitter stabilized bias, self bias, collector to base bias. Bias stabilization. Thermal runway, Thermal runway compensation.	the function of a Transistor as an amplifier.		ckt. Series & parallel ckt. Power transformer instrument transformer etc.	
22 to 24.	Small signal & Large signal Amplifier	Explanation of Amplifier. Small signal Amplifier. CB, CE, CC. R - C coupled Amplifier. Frequency response analysis by Bode Plot methods (Gain margin, Phase margin, Corner frequency, Damping factor & Stability). Multistage Amplifier, TC, DC, Large signal & Power Amplifier. Class-A, B, C & AB, (Biasing, operation, efficiency & power	Demonstration assembly and testing of a transistor amplifier in class A, B, C, P – P complimentary symmetry modes. Demonstration of Bode plots method. Coupled Amplifier frequency response plot by Bode plot methods. Assembly testing frequency response of a single stage A.F. amplifier and R.F. amplifier.	Multimeter, Milli-ammeter, micro-ammeter, milli-voltmeter. Transistor tests. Signal Generator Oscilloscope.	– do –	Properties of Triangles, Simple problem of Height & Distance

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1	2	3	4	5	6	7
		calculation). A.F. amplifier, wavelength propagation vol. of sound. R.F. amplifier. Class-B push pulls amplifier ckt. Operation, Power efficiency & distortion, advantage, crossover distortion. Complimentary symmetry. Quasi-Complementary symmetry amplifier. Distortion, total harmonic distortion. Heat sink & Thermal analogy.	Study of P.C.B. of an amplifier. Fault location and servicing of a amplifier.	Multimeter, D.C. Low voltage power supply, Signal Generator, A.F. – Do – R.F. HF oscilloscope output meter.		
25 to 27.	Feedback Amplifier, Oscillators & Multivibrator	Concept of feedback, positive negative feedback. Calculation of negative feedback on gains, gain stability. Use of positive feedback & negative feedback. Typical application of negative	Demonstration on various oscillators. Study of feedbck in an oscillator ckt. Assembly of an A.F. oscillator testing & measuring th 'f' of generated oscillations. Study of	Various AF & RF oscillators. Multimeter oscilloscope, Frequency counters. Remote control devices-Toys etc.	Free hand sketching of plan & elevation of simple objects-hexagonal bar, sq. bar, circular bar,	Power transmission by Shaft, Belts & ropes

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1	2	3	4	5	6	7
		feedback *i.e.*, Emitter follower, Darlington pair. Concept of Oscillation. Nyquist Criterion (Gain margin & stability). Bark hausen Criterian. Damped and Un-damped oscillation & controlling factor. Classification of oscillators. Sinusoidal oscillator : Tuned, Hartley, Colpitt, R-C phase shift and Wein bridge, Crystal Non-sinusoidal oscillators : A-stable, Mono-stable. By stable Multivibrator. Relaxation oscillator. Blocking oscillator. Use of oscillator in T.V., Tape recorder, Function Generator & oscilloscope	an R.F. oscillator. Faultfinding & Servicing of oscillator.		tapered bar, hollow bar etc.	

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1	2	3	4	5	6	7
28 & 29.	Power supply, SMPS & UPS	Explanation of power supply, Importance. Types of regulated & un-regulated power supply. Explanation of regulated power supplies (using Transistor & IC's). Block diagram of SMPS, Invertor, Converter and UPS.	Demonstration of various power supplies. Assembly & testing of an unregulated & regulated power supplies, series, shunt regulated power supplies. Assembly & testing of a voltage stabilizer as per specification to be used for a T.V., Refrigerator. Demonstration on U.P.S. system. Assembly & testing of a S.M.P.S. for a C.T.V. & Computer.	Reading of simple ckts. UPS (small VA).	Calculation of areas of triangles, polygons with the aid of trigonometry.	Concepts of lifting machine, idle machine, velocity ratio, Mechanical Advantage, Relation between them.
30.	Introduction of communi-cation	Need of Modulation and Demodulation, type of modulation, Transmitter, Receiver, channel noise,			–do –	–do –

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1	2	3	4	5	6	7
		band width requirement. Noise : External noise, Thermal noise, Short noise, transit noise, flicker noise, noise figure.				
3	Analog communi-cation	Amplitude Modulation : A.M. theory, frequency spectrum and power relation, Depth of modulation, A.M. Modulation and demodulation block diagram and working. Amplitude modulation & Demodulation techniques. Average and peak envelop detectors, simple ckts. For generation & detection of A.M. signal, SSB, DSB, SSB-SC, DSB-SC, balance modulation and	Experimental study and operation of A.M., F.M. & P.M. Through trainer kits. Demonstration of sampling & Quantization on Trainer kits.	Oscilloscope, Multimeter, Trainer kits of A.M., F.M., P.M. & Sampling.	Symbols as per different semi - conductor devices - LDR, VDR, Thermister & their use in ckts.	Vector - Defination of Scalar and Vector, notations and representation of vectors.

1	2	3	4	5	6	7
		generation. Advantage & disadvantage. Frequency and Phase Modulation : Frequency and Phase modulation, basic waveforms. Modulator Demodulators (Block diagram) and their working. Noise consideration and disadvantage of F.M. and P.M. Statement and Phase modulation, basic waveforms, modulator Demodulators (Block diagram) and their working. Noise consideration and disadvantage of F.M. and P.M. Statement of sampling theorem for low pass signal & natural. Flat top sampling & quantization.				

1	2	3	4	5	6	7
32 & 33.	Audio system	Explanation of sound propagation, sound, importance of channels in sound system. Explanation of microphones — types, uses specification etc. Explanation of Loud Speakers — types matching of speakers/ Horns/Baffles/ enclosures. Line transformers. Explanation of stereo system. Stereo amplifiers. Arrangement of stereo for a specified area. Surround sound systems.	Demonstrations and testing of various microphones. Identification, testing & servicing of microphone Spares. Identification, testing & servicing of Loud Speakers. Arrangement of speaker/ Horns in a room/ Auditorium & for an open gathering. Impedance matching. Demonstration on 2/4/6 channel stereo system.	Assorted microphones. Assorted Loud Speakers. Assorted Horns A.F. amplifier Line transformer. Multichannel stereo system. Multimeter. E.V.M. oscillo-scope.		Addition and subtraction of vectors. Scalar and cross product. Simple problems.
34 & 35	Radio wave propagation	Electromagnetic Radiation, propagation in free space, tropospheric and Ionospheric, surface, sky and space waves. Skip distance, critical			Drawing of A.F. amplifier ckt with six stage & with types of O/P P-P	

1	2	3	4	5	6	7
		frequency. Maximum frequency, Maximum usable frequency (MUF). Fading.				
36 & 37.	Radio receiver, Tuning section, I.F. Stage and Detection. Audio stage, Fault Finding.	Full explanation of Radio receiver Super-heterodyne principle of "frequency changing" Radio chain, terms used in radio transmission. Explanation of 'frequency' ranges Resonance. Image frequency, acceptor ckt. & Rejector ckts. Disadvantages of R. F. Amplification, Sensitivity and selectivity. Fideality. Signal to noise ratio. Block diagram of a radio receiver.	Demonstrations on a multiband Radio receiver. Study of radio ckt. M.W. – Do – Multiband, Identification of I.F. stage. Identification of A.F. stage. Study of assorted 'Band Switch's' practice on 'Dial Threading'. Study of the PCB of the R/R ckt.	Assorted Radio Receivers (Multiband). Multimeter. Oscilloscope.	Block diagram of an oscillator. Symbols for diff. Wave shapes-sq. saw tooth, sine, triangular etc.	

1	2	3	4	5	6	7
	Tuning section (R.F. section)	Explanation of tuning section/ R.F. section. Block diagram. Antenna ckt. Mixer stage, I.F. generation. R.F. amplifier A.G.C. types of transistors used. Specifications of Ant. & oscillator coils with types of 'Gang condensers'. Types of 'band' switches. Used – connections conditions for better selectivity ant. Sensitivity.	Study of R. F. section of R/Rs for both P.N.P/N.P.N. Ant. & oscillator alignments. Study of different band switches. Fault finding & servicing of R.F. stage. Checking of selectivity. Checking of sensitivity.	R/R - both PNP. And NPN. Multimeter signal generator. oscilloscope. D.C. power supply.		
	I.F. Stage and Detection	Explanation of I.F. the importance of I.F. ranges for M.W. & S.W. ckt. Analysis of I.F. stage. Transistor/ I.C. used, their characters. Alignment of I.F. stage. Explanation of detection/demodulation. R.F. by pass. Tuning	Study of I. F. stage of R/R for both PNP/NPN. Study of detector stage of R/R for both PNP/NPN. Study of A.V.C / A.G.C. ckt. Alignment of I.F.T. for desired T.F. testing of I.F.T.	R/R - both PNP. And NPN. Multimeter. E.V.M. signal generator. Signal tracer oscillo-scope.		

1	2	3	4	5	6	7
		indicators with ckt. Arrangement types. A.V.C/A.G.C. Line, importance.	replacement of I.F.T. and realign-ment. Fault finding by meter/ by signal traces/ by scope.			
	Audio Stage	Explanation of audio stage, types of amplification, driver stage, output stage. Transistors used. Tone control, Vol. Control.	Study of audio stage, driver stage, output stage, tone and Vol. Control stage. Fault finding and servicing.	– do –		
	Fault Finding	Preparation of servicing charts for fault finding in audio amplifiers are in R/Receivers. Dara sheet & history sheet. Replacement charts/ equivalent charts.	Servicing practices.	Signal tracer oscilloscope.		
38.	F.M. Receiver	Block diagram of F.M. receiver & explanation of each stage. Detector (Ratio detector, Foster-seely Discriminator).			– do –	

1	2	3	4	5	6	7
39 & 40.	A.M. & F.M. Transmitter	Full explanation of A.M. of F.M. Transmitter. A.M. & F.M. transmitter block diagram & explanation of each stage F.M. stereo transmitter.			Drawing of AM & FM modulated wave at various modulation - 100 pc, 50 pc etc.	
41 to 43.	Special semi-conductor device	Expl. of characteristics, uses of UJT, FET, MOS-FET, SCR, SCS, SBS, DIAC, TRIAC, I.C., IGBT, GTO, IGCT, PUT.	Study & assembly of a UJT. Triggered ckt. Study and assembly of FET. Amplifier ckt. Study of a ckt. Using MOSFET. Study of a ckt. SBS & SCS. Study of SCR in D.C. study of SCR in A.C. study of voltage control by SCR. Study of DIAC, TRIAC. Study of I.C. ckts. Amplifier switching ckts.	Models of UJT. Triggered ckt. FET as power Amplifier. Models as SBS, SCS. Electronic power regulator. Analog I.C. tester. oscillo-scope. Multim-eter. E.V.M. function genera-tor.	Exercise on Blue print reading/ckt. Reading of house service connections & small power ckts. Connection of Ammeter voltmeter, wattmeter kWh-meter with I.S.I. symbols ckt. Reading & drawing of	

1	2	3	4	5	6	7
44 to 46.	Op-Amp. & Timer	Ckt. operation of differential amplifier. Single ended & double ended operation. Calculation of gain & I/P Impedance of differential amplifier in different mode & common mode. Introduction of OP-Amp. Characteristics, CMRR, Op-Amp. Parameter : I/P offset Voltage, I/P offset Current, I/P bias current, Slew rate, Gain B-W. Virtual ground. Constant gain. Unity gain. Op-Amp application : Adder, Scale changer, Phase shifter, Voltage follower, Integrator, Differentiator, and Comparator. Instrumentation	Terminal checking & terminals identification of Op-Amp. Op-amp as an adder, inverting Amplifier, non-inverting Amplifier, comparator, Integrator. Differentiator. Study of D.C. Timer.	Assorted Op-Amp. Assorted relay. SCR driven timers Multim-eter	diff. stages of R/R/free hand sketching of trade objects.	

1	2	3	4	5	6	7
		Amplifier. Expl. of Timer, Types of time constant etc.				
47 & 48.	Wave shaping circuits	Diode clipping ckts. Clamping ckts. Schmitt trigger, Square wave & Triangular wave generator.	Study of different pulse shaping ckts.	Function generator, oscilloscope.		
49 to 52.	Digital meter, oscilloscope & Function generator	Digital Voltmeter block diagram & explanation of each block. Oscilloscope block diagram, Vertical deflection system, Horizontal deflection system block diagram & explanation. Delay line ckt. (Block diagram). Dual beam, Dual traces. Oscilloscope. Basic idea of storage and Sampling Oscilloscope.	Demonstration of digital voltmeter. Study of different sections of CRO, general faultfinding & testing. Operation of CRO. Example of 'X' & 'Y' axes controls. Measure-ments of D.C. voltage, A.C. voltages frequency etc. comparison of waver. Use of scope in testing & fault location. Test on	**Oscilloscope Trainer kit. Function Generator Trainer kit.** CRO, L.P. & H.P. signal generator, VIDEO FILM of CRO. Digital voltmeters/ Digital Multim-eter.		

1	2	3	4	5	6	7
		Frequency & Phase measurement by CRO, Block diagram of Sin wave generator, Sweep generator, Digital frequency counter	Lissejus pattern. Demonstration on Function Generator of different section.			
53 to 55.	Digital Electronics (Number system & Logic gates)	Binary, Decimal, Octal, Hexadecimal conversion from one number system to another. Binary addition, subtraction, 1's & 2's Complements.	I.C. gate testing & terminal identification of NOT, OR, AND, XOR, XNOR & Verification of truth table.	Assorted TTL/CMOS I.C. digital Multimeter.		
		Subtraction using 1's & 2's compliments. BCD Code. Standard logic gates (NOT, OR, AND, XOR, XNOR, NAND, NOR). Its characteristics. Universal gates.	Verification of Universal gates ckts.	Assorted I.C. digital Multimeter.		

1	2	3	4	5	6	7
56 to 58.	Boolean Algebra & logic ckts	Boolean algebra laws, Postulates, Theorem, Boolean functions, standard canonical forms, Realization with gates K-Map representation of logic function, Max. term, Min. term. Don't care condition Half adder, Full adder, Half subtraction, Full subtraction, Decoder, Encoder, multiplexer, Demultiplexer, Multiplexer tree.	Experimental verification of Boolean expression by Gates. (Simple problems). Verification of full adder, Half-adder, Full-subtractor, Half-subtractor, multiplexer, Demultiplexer, Encoder, Decoder using logic Gates.	Assorted I.C. digital Multimeter.		
59 & 60.	Flip-Flops & Counter	Introduction, F/F Basic Gates, Construction of different ckt. R-S. F/F, T-F/F, J-K F/F, D-F/F, Master-Slave F/F, Edge trigger F/F. shift Registers: SISO, PIPO, PISO, SIPO, Bi-directional register, Ring	R-S F/F, D- F/F, T-F/F, J-K F/F, with clock. Left shift resistor, Right shift resistor. Up counter, Down counter, Ring-counter, Mod- 10 counter. Study of	Assorted F/F. & FND. Trainer kits of A to D & D to A. Converter. Digital Multimeter.		

1	2	3	4	5	6	7
		Counter and twisted ring counter, Asynchronous counters: UP-Dowm counter, MOD-N counter, Synchronous Counters, 7-segment display & drivers.	the characteristics BCD to 7-segment decoder.			
61 & 62.	D/A, A/D Converter & Memories	D/A converter, Weighted Resistance, R-2R Ladder, A/D converter, Successive approximation counter type. Dual slop A/D converter. Characteristics and function of different type memory as semiconductor and magnetic, ROM, PROM, EPROM, EEPROM, MOS, RAM (Static and Dynamic). Read Write memory. Flash ROM, Optical memeory, OCR, MICR, charge coupled memory. SRAM, DRAM.	D/A conversion & A/D conversion.	Trainer kits of A to D & D to A Converter, Digital Multimeter.		

1	2	3	4	5	6	7
63 to 68.	Micro-processor	Introduction to Microprocessor. Use of Microprocessor. Block diagram of Intel 8085, its instruction set, Addressing modes, Pin configuration, Instruction cycle, Timing diagram of fetch, read & write cycles, Interrupts. Memory mapped I/O, I/O mapped I/O. Assembly language programs, looping, Arithmetic operation related to memory, logic operations, Rotate and Compare, Intel 8086 Architecture, Pin configuration and Addressing modes. Brief introduction of	Introduction to Microprocessor Trainer kit. Idea about how to run a program in Trainer kit. Program on addition by indirect & direct addressing method. Program on subtraction, multiplication. Program on logical gates truth table. Program to find out larger & smaller Number of two & three numbers. Program check by a bit condition of a data byte. Application of I/O port by using a single program. Demon-strate application of Microprocessor in	Microprocessor Trainer kit - 8085/8086. EPROM kit.		

1	2	3	4	5	6	7
		32 & 64 bit Microprocessor. Introduction to programmable peripheral interface 8255, Time counter 8253/8254, Interrupt controller 8259 and DMA controller 8237 & 8251A. Chief set controlling microprocesor. Introduction to micro controller & Embedded system.	T.V. CD & DVD. Demonstrate applica-tion of Micro controller in TV. CD & DVD, Washing machine, Micro oven.			
69 to 72.	T.V. System	Expl. of T.V. systems B & W block diagrams for both. Transmitter & Receiver. Idea about Video camera. Scanning system. Frame, Field, Raster, Picture elements. Composite video signal. Aspect ratio,	Demonstration on a B & W T.V. identification of diff. Controls. -Do- Tuner, testing & replacement. -Do- wave trap ckt. & Testing. -Do- Video I.F. -Do- Staggered	Video film – How T.V. works. T.V. sets B & W make diff. Company with servicing manual. Pattern generator. Multimeter.		

1	2	3	4	5	6	7
		resolution, flickering, contrast, Brightness video sifgnal, sound signal channels, Bands. Expl. Data preparation. For Tuners: Electronic. -Do- Filter ckt. SWAF. -Do- Video I.F. with staggered tuned. -Do- Video amplifier & picture tube. -Do- Sweep section & E.H.T. -Do- Sound section. -Do- Power supply T.V. Antenna YAGI & feeder cables.	tuning of video I.F. -Do- Video amplifier. -Do- Picture tube. -Do- Sweep ckt. -Do- Horizontal- E.H.T. -Do- F.M. sound. -Do- section. - Do- power supply. - Do- S.M.P.S. -Do- S.T.R. -Do- Preparation, servicing chart. Installation of T.V. antenna.	Data book. **T.V. TRAINER KIT.** Sweep generator with X - Y display.		
73 to 78.	Colour T. V.	Expl. of colour T.V. Functional Block diagram. Expl. ckt. Description and test points of Tuner: - Do - V.I.F. - Do - A.G.C.	Demonstration on C.T.V. identification & use of diff. Controls. identification, study & test points of Tuner. -Do-	C.T.V. (diff. make) with manual. Colour pattern generator. Multimeter. **C.T.V.**		

1	2	3	4	5	6	7
		- Do - Video Amplifier. - Do - Synchronization & Sweep ckt. -Do- Matrix. -Do- Picture tube. -Do- Sound section. - Do - Power supply. Preparation of servicing charts/data sheet. Faultfinding step by step. Balancing of white colour.	V.I.F. -Do- Video amplifier. -Do- Sync, sweep ckts. -Do- picture tube. -Do- sound sec. -Do- power supply. Faultfinding Adjustment of white colour.	**TRAINER KIT.** Oscilloscope. Sweep generator with 'X-Y' display. Video film 'How CTV works'.		
79 to 81.	CD & DVD	Introduction to VCD. Optical recording on Disc. Principle Through block diagram. Play-Back process, VCD Features. Introduction to DVD. DVD Format, DVD pickups. DVD Encoding and Decoding. DVD Features. Safety precaution in DVD. Discussion on Mechanical operation, Adjustment & replacement.	Stage location. Identification of components. Demonstration on Disc-drive mechanism. - Do- DVD. Discuss on common fault.	CD & DVD (diff. make).		

1	2	3	4	5	6	7
82 to 87.	Digital communication, Satellite communication & Microwave	Introduction to digital communication. PCM, Explanation the diff. Between analog and digital communication. Explain the waveform coding by sampling & Quantization. Operation in a PCM system. Define Companding. Explain the encoding operation in a PCM. Regeneration and reconstruction of PCM wave. Delta modulation: explain the principle of Delta Modulation technique using block diagram. Limitation of Delta modulation due to fixed step size. Concept of Adaptive Delta modulation Technique.	Study of A. M, F. M. PCM, PAM, PPM, PWM. Study of demodulation of PCM, PAM, PPM PWM.	Oscilloscope. Digital Multimeter. Trainer kits of modulation & demodulation (A.M, F.M, PCM, PAM, PPM, PWM).		

1	2	3	4	5	6	7
		Multiplexing: Define multiplexing and its need. List the types of multiplexing. Explain the principle of ASK, PSK, FSK, QPSK and comparison of them. Function, Block diagram & example of Satellite sysem. -Do- Microwave and Radar system. -Do- navigation I.L.S.				
88 to 92.	Telephony	Diff. types of Exchanges. Conception of transmission & switching & reception of them. Idea of local battery. Telephone set and central battery Telephone. Telephone transmitter, Receiver, various tones ckt. Push button telephone	Demonstration of local battery set. Demonstration of push button telephone set. Cordless telephone set & Faultfinding. Demonstrate Cellular telephone set. Study of EPABX (Electronic Exchange).	Push button telephone sets. Dialing telephone sets. Cord- less telephone sets. Cellular telephone set. Trainer kit of EPABX (Electronic Exchange). Multimeter Oscillscope.		

1	2	3	4	5	6	7
		set. Dialing system. Electronic Exchange: Block diagram and diff. stage of Automatic exchange based on SPC system. Facility & advantage of exchange. Cellular Telephone system, cell & cell site, Roaming. Block diagram and diff. stages of cellular system. GSM, CDMA. Concept of WILL MDF.				
93.	Computer peripheral	Mother board : Introduction, Explain Bus/Slots, CPU, Co-processor, memory structure, SIMM & SIP, DIMM, module, memory organization & management, memory bank, support	Introduction of diff. sections of 80286, 386, 486, up to P-IV Microprocessor based motherboard. Identification of diff. Card like VIDEO, IDE, SIMM, DIMM			

1	2	3	4	5	6	7
		chips. Diff. Types of Motherboard & CPU socket/Slots. CMOS (BIOS) setup, error detection (by beep & codes).				
94.	FDD & HDD.	Introduction of FDD, Floppy disk, error messages. Introduction of HDD error messages. Modern storage device *i.e.*, Pen-drive.	Identification of diff. sections of FDD and faultfinding, -Do- HDD. Hard disk drive partitioning, formatting and loading of operating system. Assembling of system and faultfinding. Ckt. tracing of keyboard and faultfinding by Multimeter. Fault identification of mechanical Mouse	Different types of Intel processor with mother board. (Up to P-IV). Diff. types of Cards (LAN, Display, IDE/IO, Sound card, SCSI Controller card etc.) Hard disc drives, FDD - 1.44. Blank Floppy, Blank CD. Hard disc cable, Floppy drive cable etc. SMPS, Mouse, Keyboard,		
95.	Keyboard & Mouse.	Introduction, function of keyboard & Mouse, Interfacing, pre-directional serial & parallel communication, keyboard organization, Mouse installation; types of mouse: Mechanical, optical, opto-mechanical, serial, Bus Mouse.				

1	2	3	4	5	6	7
96.	I/O card	Introduction of diff. Daughter cards. Process of identification of diff. Daughter cards (IDE, VIDEO, ETHERNET). Smart card, smart card redder.	& opto-mechanical Mouse. Practical on CMOS-Setup. Installation of CD-ROM drive.	Cabinet, Monitor etc. Operating system (WIN-XP, WIN-2000). Antivirus software. PC's with monitor. Running PC's with monitor for software installation. Multimeter, Screw driver Sets, Nudges pliers. Climping Tool. RJ-45, Connector, Cat-5 or Cat-6 Cable.		
97 & 98.	Network & Communica-tion	Serial and parallel communication RS232, RS485, RS422 and other standards. Concepts of Networking of computer, LAN, WAN, MAN etc. Introduction to	Demonstration of LAN system.			

1	2	3	4	5	6	7
		communication standard like — ETHERNET, ARCNET, CONTROLNET, PROFIBUS				
99 & 100.	Opto-electronics & study of specific device	1. Photo device. 2. Thermocouple & R.T.D. 3. Level controls. 4. Tacho generator 5. Alarm ckts. 6. Remote control. Sensor & actuator	Study of photo devices. - Do - Temperature control ckt. - Do - level control ckt. -Do - tacho generator ckt. -Do - remote control.	Models of photo device. Operating ckt. Level control ckt. Tacho-generator.		

LIST OF TOOLS AND EQUIPMENTS FOR THE TRADE OF 'ELECTRONIC MECHANIC' (CTS)

(for the batch of 16 trainees)

S. No.	Description	Quantity
1	2	3
TRAINEES' KIT		
1.	Combination Plier 15 cms insulated	16
2.	Long nose insulated plier 15 cms	16
3.	Diagonal cutter 15 cms insulated	16
4.	End Cutting nipper insulated 15 cms	16
5.	Tweezers 10 cms insulated	16
6.	Heat sink plier	8
7.	I.C. Tweezer / Puller	16
8.	Neon glow tester	16
9.	Knob Screw driver insulated 10 cms.	16
10.	Screw driver set of 6	8
11.	Watch maker screw	8
12.	Knife electrician	16
13.	Adjustable spanner / slide wrench (15 - 20 cis)	8
14.	Wire stripper	8 sets
15.	Allen key	1 set
WORKSHOP TOOLS AND EQUIPMENT		
16.	Fire extinguisher	1 no.
17.	Fire aid kit	1 no.
18.	Artificial Respiration Chart	2 nos.
19.	Work benches 120 × 400 × 75 cm	4
20.	Rubber mat — 180 × 45 × 2.5 cm	3
21.	Rubber gloves pair	1 set
22.	Steel ruler 30 cm	8 nos.
23.	Sciber 15 to 20 cm	4
24.	Center punch 10 cm	4
25.	Hammer Cross pane 110 cm with handle	2
26.	Hammer ball pane 220 cm with handle	2
27.	Spanners double ended metric system 6 mm to 19 mm by 1.6 mm	4 sets
28.	Spanners single ended 6 mm to 25 mm by 1.6 mm	2 sets
29.	Box spanner set of 4 - 15 mm	1 set
30.	Mallet 8 oz.	2 nos.
31.	Gimlet	2 nos.
32.	Saw tenon 25 cms	2 nos.
33.	Chisel wood 15 cms set of 6 mm to 25 mm	2 sets
34.	Chisel cold flat 10 mm	2 nos
35.	Hand shears metal cutting 25 cms	2 nos
36.	Bradawl	2 nos

1	2	3
37.	Ratchet brace drill 10 m	2 nos.
38.	Electric drill 10 mm with polishing and buffing accessories	2 nos.
39.	Hacksaw 20-25 cm (adjustable)	4 nos.
40.	Valve base cutter	2 sets
41.	Hand operated bending brake	2 sets
42.	Junior saw 20 cms.	2 nos.
43.	File flat 20 cms 2nd cut	4 nos.
44.	-do- 15 cms bastard	4 nos.
45.	-do- half round 20 cms bastard	4 nos.
46.	-do- round 20 cms 2nd cut	4 nos.
47.	-do- Flat 20 cms	4 nos.
48.	Instrument files set of 12	2 sets
49.	Vice Bench 10 cms Jaw	2 nos.
50.	-do- 5 cms Jaw	4 nos.
51.	Taps set 3 mm to 10 mm (set of 9)	2 sets
52.	Dies set 3 mm to 10 mm	2 sets
53.	Grinder bench electric	1 no.
54.	Equipment soldering iron 35 W	20 nos.
55.	-do- 250 W	2 nos.
56.	-do- 65 W	20 nos.
57.	-do- 10 W	10 nos.
58.	Temperature controlled soldering station, 15 W	1 no.
59.	Desoldermg pump & Desolderwive	2 nos.
60.	Wire gauge set	2 nos.
61.	Feeler gauge	2 nos.
62.	Permanent Bar magnet 15 cms	2 nos.
63.	Solenoid with core	2 nos.
64.	Electric bells	16 nos.
65.	-do-	4 nos.
66.	Battery eliminator	8 nos.
67.	Battery storage lead acid	2 nos.
68.	Hydrometer	2 nos.
69.	Rheostats assorted values and ratings	25 nos.
70.	Variable resistances/Potentiometer (**H.T.)	25 nos.
71.	Insulation Tester	2 nos.
72.	Climbing Tool (RJ-45)	2 nos.
73.	Transistor Tester	1 no.
74.	I.C. Tester	1 no.
75.	Logic Probes (**H.T)	1 no.
76.	Fractional H.P. AC meters (**MI)	2 nos.
77.	-do- DC meters	2 nos.
78.	DC/AC Ammeter 0-50 mA	2 nos.
79.	-do- 0-500 mA	2 nos.
80.	-do- 0-1 mA	4 nos.

1	2	3
81.	-do- 0-5 mA	4 nos.
82.	-do- 0-100 mA	2 nos.
83.	Multimeter small (Analog)	10 nos.
84.	DC/AC Ammeter 0-50 mA	2 nos.
85.	Digital multimeter [Range MA(AC/DC) mA & Ampm voltage AC/DC]	10 nos.
86.	E.V.M.	1 no.
87.	Thermo-couple meter R.F. 100 mA	1 no.
88.	-do- 0-500 mA	1 no.
89.	DC/AC Voltmeter 0-5 V	4 nos.
90.	-do- 0-10V	4 nos.
91.	-do- 0-50 V	4 nos.
92.	-do- 0-500 V	2 nos.
93.	Watt meter 5/250 V	1 no.
94.	Output meter (** MI)	2 nos.
95.	Constant voltage transformer / Auto	4 nos.
96.	Coil winding m/c. (manual)	1 no.
97.	Commercial Receiver transistorized / IC	2 nos.
98.	P.A. Amplifier	2 nos.
99.	Loudspeakers	16 nos.
100.	Microphone (assorted)	6 nos.
101.	Headphone earphone	4 nos.
102.	Receiver aco real kit	2 nos.
103.	Service Oscillator	4 nos.
104.	Signal tracer	4 nos.
105.	A.F. Oscillator	4 nos.
106.	Frequency modulator	2 nos.
107.	C.R.O.	6 nos.
108.	Power Supply 0-30 V / DC. 0-300 V	2 nos. each
109.	Sweep generator with X-Y display with marker	2 nos.
110.	T.V. Camera B/W & Colour	1 each
111.	A.C. Bridge	1 no.
112.	Styles pressure gauge	1 no.
113.	T.V. Trainer kit	1 no.
114.	T.V. Receiver B/W (Solid State)	3 nos.
115.	T.V.Receiver coloured with latest technology	3 nos.
116.	Pattern generator B/W & Colour	2 nos .each
117.	Signal generator AM/FM	4 nos.
118.	Signal injector	2 nos.
119.	Distortion meter	1 no.
120.	Loudspeaker	2 nos.
121.	Strain gauge with load cell	2 nos.
122.	VCD	1 no.
123.	DVD	1 no.
124.	Micro Processor Training Kit (8025/8086)	4 nos.

1	2	3
125.	Steel Cabinet 120 × 60 × 40 cm	4 nos.
126.	Steel lockers with 16 drawers	2 nos.
127.	Digital I.C. Trainer	2 nos.
128.	Logic Probes	1 no.
129.	Frequency Counter	1 no.
130.	A.F./R.F. Oscillator	2 nos.
131.	Inter Com. System	1 no.
132.	C.R.O. Trainer kit	1 no.
133.	Function Generator Trainer Kit	1 no.
134.	Push bottom telephone set	2 nos.
135.	Cord less telephone set	2 nos.
136.	Cellular telephone set	2 nos.
137.	Computer system (latest config) with CD writer	1 no.
138.	Software (M.S.Office 2000 latest version)	1 no.
139.	Antivirus and software (latest)	1 no.
140.	SMPS	2 nos.
141.	UPS (Small W)/UPS Trainer	1 no.
142.	A.M.Trainer kit (Modulation & Demodulation)	1 no.
143.	F.M.Trainer kit (-do)	1 no.
144.	P.M. Trainer kit	1 no.
145.	Sampling & Qualification Trainer kit	1 no.
146.	PAM Trainer kit (Modulation & Demodulation)	1 no.
147.	PCM -do-	1 no.
148.	PWM -do-	1 no.
149.	PPM -do-	1 no.
150.	EPABX -do- (Electronic Exchange)	1 no.
151.	Printer (Desk tab/lesser)	1 no.
152.	Blank floopy, Blank CD	Consumable
153.	RJ 45 connector, Cat-5/Cat-6 Cable	-do-
154.	F.D.D. (1.44)	5 nos.
155.	C.D Drive	5 nos.
156.	Hard Disk	5 nos.
157.	Operating System (WIN-XP, WIN-2000 & latest)	1 no. each
158.	Running P.C.'s with Monitor	4 nos.
159.	EPROM Kit	1 no.
160.	A to D Trainer Kit	1 no.
161.	D to A Trainer Kit	1 no.
162.	Power supply ±5 V & ±12 V DC	8 nos.

SYLLABUS FOR THE TRADE OF ELECTRONIC MECHANIC UNDER APPRENTICESHIP TRAINING SCHEME

Period of Training - 3 Years

The period of training for this trade is 3 years. The first two years training should be the same as the practical operations/skills of the two years course for the ITI trainees of trade Mech. (Radio & TV) or Mechanic (General Electronic). For the remaining period i.e. in 3rd year the shop training would include the operations/skills as per the syllabus for this trade.

(The syllabus for this trade should be considered as a guide for imparting apprenticeship training according to the facilities available in Industry/Establishment).

List of operations/skills to be learnt during Apprenticeship Training :

1. **First Year**

   The practical training during the first year of apprenticeship training should have the same operations/skills as that of the first year of the two year course of the ITI in the trade of Mech. (Radio & TV)/Mechanic (General Electronic) using the Tools/Equipment prescribed for these trades.

2. **Second Year**

   The Practical Training during the second year of the training should also have the same operations/skills as that of the second year of the two year course of the ITI in the trade of Mechanic (Radio & TV)/Mechanic (General Electronic) using the Tools & Equipment prescribed for these trades.

3. **Third Year**

   In the Third year of Apprenticeship Training, the apprentice will receive Shop Floor Training with special reference to safety, manufacturing process, general testing, and maintenance techniques of electronic components and equipments etc. He should develop his method of work, speed, accuracy and finish in jobs, which would normally

consist of operations/skills already learnt by him earlier. Also, the apprentice will receive Shop Floor Training in one of the major areas of activities of the industry/establishment, which would fall in at least any one of the identified groups in this syllabus.

Common Shop Floor Training (4 Months Approx.)

1. **Safety :** Safety precautions, first aid and artificial respiration, Elements of fire fighting - various types of fire fighting equipment.
2. **Manufacturing Techniques/Processes :** The shop floor training to be given in as many manufacturing techniques/ processes as possible depending upon the facilities available in the industry concerned e.g.
   - (*i*) Soldering, brazing and welding
   - (*ii*) Wire stripping & forming
   - (*iii*) Sheet metal working, punching & drilling.
   - (*iv*) Finishing processes—polishing, buffing, spray painting.
   - (*v*) Electrode position of metals on non-conductors.
   - (*vi*) Electroplating processes.
   - (*vii*) P.C.B. - single layer-multilayer.
   - (*viii*) Vacuum impregnation.
   - (*ix*) Bakelite and plastic moulding.
3. **General Testing**

   (*a*) Testing of components such as :
   - (*i*) Resistors
   - (*ii*) Coils
   - (*iii*) Capacitors
   - (*iv*) Ferrite components
   - (*v*) Transducers
   - (*vi*) Crystals
   - (*vii*) Relays
   - (*viii*) Micro-switches
   - (*ix*) Plugs & sockets
   - (*x*) Active components
   - (*xi*) Plated metal parts

(*b*) Bulk Testing of Electronic Components using Test Rigs & Jigs.

(*c*) Use of Test Instruments such as :

(*i*) Insulator Tester
(*ii*) Vacuum tube tester
(*iii*) Transistor tester
(*iv*) I.C. tester
(*v*) Logic circuit tester.

4. **Inspection**

Step-wise and final inspection procedures and other quality control techniques.

5. **Maintenance**

(*a*) Wiring of an electronic maintenance/test bench
(*b*) Modern trouble shooting sequences & techniques for electronic equipments.
(*c*) Replacement of defective components in -
(*i*) Simple electronic circuits on chasis.
(*ii*) P.C.B. circuits.
(*iii*) Hybrid circuits.
(*d*) Care in replacement of sockets for -
(*i*) Vacuum tubes
(*ii*) Transistors
(*iii*) I.Cs.

6. **Transformers & Coils**

(*a*) Care and maintenance of the following transformers :
(*i*) Power
(*ii*) A.F. - Input - driver-output
(*iii*) I.F.
(*iv*) R.F.
(*v*) Rewinding of small transformers
(*vi*) Winding of R.F. coils, deflection coils etc.

MAJOR GROUPS

(At least One Group to be covered during shop-floor training - 8 months approx.)

Group - A

Domestic Electronics

Shop Training is assembling, aligning, testing and servicing of any one or more of the following equipment :

(*a*) Radio Receiver (Tube, Transistor & Hybrid Versions).
(*b*) Black and White T.V. Receiver (Tube, Transistor and Hybrid Versions).
(*c*) F.A. Systems, Stereo Amplifier Systems etc.
(*d*) Tape Recorder (Cassette and Spool Type).
(*e*) Colour T.V. Receivers.

Group - B

Industrial Electronics

Shop Training in assembling, aligning, testing and servicing of **any one of or more** of the following equipment/systems :

(*a*) Speed control
(*b*) Photo Electric Control
(*c*) Welding control and Servo control.
(*d*) Process control

Group - C

Medical Electronics

Shop Training in assembling, aligning, testing and servicing of **any one or more** of the following medical equipment/ systems :

(*a*) E.C.G. systems (*d*) X-Rays systems.
(*b*) Recording systems (*e*) Other Medical Electronics Equipment
(*c*) Patient Monitor systems

Group - D

Professional Electronics

Shop Training in assembling, aligning, testing and servicing of **any one or more** of the following equipment :

(*a*) A.F. Signal generator, pulse generator.
(*b*) R.F. Signal generator.
(*c*) V.T.V.M. and multimeters.
(*d*) C.R.O.
(*e*) Power supplies and stabilisers.

(*f*) Electronic desk calculators.
(*g*) Digital systems.
(*h*) Electronic exchanges.

Group - E

Electronic Components

Shop Training in manufacture and testing of Electronic materials and components.

SYLLABUS FOR RELATED INSTRUCTIONS

Related Instruction should be imparted to all apprentices during the entire period of training. The syllabus given for related instruction should be considered as a guideline.

The syllabus to be taught to the apprentices in related instruction would be under the following headings :

(1) Trade Theory
(2) Technical Calculations and Estimating.
(3) Engineering Drawing.
(4) Industrial Development.

The contents of the syllabus in the above headings during **first two years** should be the same as the contents of the two years training course for the ITI trainees in the trade of Mechanic (Radio & T.V.)/Mechanic (General Electronic).

THIRD YEAR

I. **Trade Theory (3 hours per week or 150 hrs. per year approx.)**

(The number of hours to be spent on the different topics in the Trade Theory has been indicated. The hours indicated are flexible and are only intended as a guide).

(1) **Safety at Work**

Safety devices and measures in handling electrical and electronic equipment. Fire fighting equipment.

(2) **Revision of the work of previous two years.**

(3) **Small Motors :** Constructional features, principle of operation and applications of fractional horse power motors and micro motors.

(4) **Electro Mechanical/Magnetic Devices & Components :**

(*i*) Various types of relays and their applications.
(*ii*) Micro switches, limit switches and other types of switches and their applications in electronic systems.
(*iii*) Transformers : Input, output, power, driver, EHT & pulse transformers, their windings and applications.
(*iv*) Plugs, sockets, multipin connectors, PCB connectors, R.F. & A.F. connectors, tube, transistor and I.C. sockets.

(5) **Electronic Devices**

Passive Devices

Various types of resistors, their rating and performance characteristics. Various type of coils such as A.F., I.F. and I.F. coils, various types of capacitors such as electrolytic, paper, mica, ceramic, tentalum, polyester, styreflex, oil filled etc. their performance, ratings and applications.

Ferrites : Ferrite components and their applications.

Transducers : Types of transducers and their application in electric systems.

Crystals : Types of crystals and their applications.

Insulators : Electrical properties of ceramic, plastic bakelite, mica and other insulating materials and their applications in electronic components and systems.

Active Components

Principle of operations and performance characteristics of devices such as vacuum tubes, gas tubes, photo-tubes, CRT (including picture tubes), semi-conductor diodes (zener, rectifying, detection, tunnel, switching, diodes, gunn diodes, varactor diode and photo diodes) thermistors, VDRs, silicon and Germanium transistors, FET's UJT, DIAC's,

TRIAC's etc. and integrated circuits.

Application of the above components in common electronic equipment.

Display devices - Nixie tubes, LEDs, LCDs etc.

(6) **Electronic Modules**

Operating principles, testing and maintenance of electronic modules such as :

(*i*) Rectifier
(*ii*) Amplifier modules
(*iii*) Detector modules
(*iv*) Modulator modules
(*v*) Oscillator modules
  (*a*) Sine Wave
  (*b*) Square Wave
  (*c*) Saw Tooth Wave
(*vi*) Mixer modules
(*vii*) Differentiating modules
(*viii*) Integrating modules
(*ix*) Logic circuit modules
(*x*) Multivibrator modules
(*xi*) Multiplexer modules
(*xii*) Recorder modules
(*xiii*) Timer modules
(*xiv*) Voltage regulator modules

(7) **System Assembly**

General principles of the working and block diagrams of systems such as -

(*i*) Radio
(*ii*) TV (Black and White)/TV (Colour)
(*iii*) P.A. systems
(*iv*) Tape recorders
(*v*) Slide/Cine projectors
(*vi*) V.T.V.M.
(*vii*) C.R.O.
(*viii*) Signal generators
(*ix*) Pulse generators

(*x*) X-Ray equipment
(*xi*) Electro cardiographs
(*xii*) Recording systems
(*xiii*) Speed control of DC motors etc.
(*xiv*) Analytical instruments (Electronic)
(*xv*) Communication systems.

(8) **Testing and Calibration**

Testing procedures for domestic and professional electronic equipments.

Calibration standards.

ISI standards for various electronic equipment.

Quality testing of components and systems.

(9) **Maintenance and Servicing**

Trouble shooting techniques, modern techniques etc. proper use of electronic test instruments/ equipments for servicing electronic systems, Use of test rigs & Jigs, component substitution in handling of P.C.B. circuits and hybrid circuits etc.

General manufacturing techniques adopted to be studied for the processes such as :

(*i*) Printed circuit boards - layout, manufacture etc.
(*ii*) Soldering techniques, brazing, welding etc.
(*iii*) Jointing techniques.
(*iv*) Electroplating - anodizing, nickel plating, galvanizing etc.
(*v*) Electro-deposition of metals on non-conductors.
(*vi*) Carpentry work - fret working machines, cabinet making etc.
(*vii*) Bakelite and plastic moulding.
(*viii*) Sheet metal work - shearing, punching.
(*ix*) Thread cutting - use of taps and dies.
(*x*) Vacuum impregnating.
(*xi*) Polishing, buffing etc.

II. **Technical Calculation and Estimating**

1. Review of mathematics taught in the first two years.
2. Use of Logarithmic tables for all technical calculations.

3. Trigonometry - Use of trigonometric tables, simple problems in basic trigonometry.
4. Slide Rule - Use in technical calculations.
5. Electronic Desk Calculators : Use in technical calculations.
6. **Simple calculations on**
   - (*i*) Rating, efficiency etc. of small motors, transformers.
   - (*ii*) Rating of resistors.
   - (*iii*) Frequency response, amplification, biasing etc. of amplifiers.
   - (*iv*) Choice of rectifier, determination of rating etc.
   - (*v*) Simple LCR circuits, resonance and oscillators etc.
   - (*vi*) Coils, Q. factor, mutual inductance etc.
7. **Estimating the cost of**
   - (*i*) Domestic electronic equipment
   - (*ii*) Professional electronic equipment
   - (*iii*) Industrial control equipment

III. **Engineering Drawing**

- (*i*) Revision of previous two years work.
- (*ii*) Blue print reading.
- (*iii*) Advanced circuit diagrams, their reading and drawing.
- (*iv*) Code of practice for General Engineering Drawings according to BIS (IS : 696-1960).
- (*v*) Undertaking of basic tool assembly drawings.
- (*vi*) Free-hand sketching of actual parts of simple electrical and electronic components.

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