

MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI - 51

1	Name of Course	Certificate Course in Instrumentation (308201)																																																												
2	Max. Nos. of Student	25 Students																																																												
3	Duration	1 Year																																																												
4	Type	Full Time																																																												
5	Nos. of Days / Week	6 Days																																																												
6	Nos. of Hours /Days	7 Hrs																																																												
7	Space Required	Theory Class Room – 200 sqft Practical – 1500 sqft																																																												
8	Entry Qualification	S.S.C. Passed																																																												
9	Objective Of Syllabus/ introduction	1) Awareness of Safety precautions 2) Knowledge of Engineering skill, use of tools in assembly 3) Awareness of computer Skill. 4) Awareness of Basic Electricity & Electrical Instrumentation. 5) Awareness of Basic Electronics & Electronics Instrumentation. 6) Awareness of Measurement & Measuring Instruments.																																																												
10	Employment Opportunity	The trainee will either to be able to take up jobs with agencies which maintain and repair Instrument or with working experience will be in a position to start his own independent Business.																																																												
11	Teacher's Qualification	Diploma in Instrumentation Engg. With 3 year Teaching experience in Instrumentation																																																												
12	Training System	Training System Per Week																																																												
		Theory	Practical	Total																																																										
		18 Hours	24 Hours	42 Hours																																																										
13	Exam. System	<table border="1"> <thead> <tr> <th>Sr. No.</th> <th>Paper Code</th> <th>Name of Subject</th> <th>TH/PR</th> <th>Hours</th> <th>Max. Marks</th> <th>Min. Marks</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>30820111</td> <td>Basic Engineering & Computer Skill.</td> <td>TH-I</td> <td>3 hrs</td> <td>100</td> <td>35</td> </tr> <tr> <td>2</td> <td>30820112</td> <td>Measurement & Measuring Instruments.</td> <td>TH-II</td> <td>3 hrs</td> <td>100</td> <td>35</td> </tr> <tr> <td>3</td> <td>30820113</td> <td>Basic Electrical, Electronics & Instrumentation</td> <td>TH-III</td> <td>3 hrs</td> <td>100</td> <td>35</td> </tr> <tr> <td>4</td> <td>30820121</td> <td>Basic Engineering & Computer Skill.</td> <td>PR-I</td> <td>3 hrs</td> <td>100</td> <td>50</td> </tr> <tr> <td>5</td> <td>30820122</td> <td>Measurement & Measuring Instruments.</td> <td>PR-II</td> <td>3 hrs</td> <td>100</td> <td>50</td> </tr> <tr> <td>6</td> <td>30820123</td> <td>Basic Electrical, Electronics & Instrumentation</td> <td>PR-III</td> <td>3 hrs</td> <td>100</td> <td>50</td> </tr> <tr> <td></td> <td></td> <td align="center">Total</td> <td></td> <td></td> <td align="center">600</td> <td align="center">255</td> </tr> </tbody> </table>					Sr. No.	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Min. Marks	1	30820111	Basic Engineering & Computer Skill.	TH-I	3 hrs	100	35	2	30820112	Measurement & Measuring Instruments.	TH-II	3 hrs	100	35	3	30820113	Basic Electrical, Electronics & Instrumentation	TH-III	3 hrs	100	35	4	30820121	Basic Engineering & Computer Skill.	PR-I	3 hrs	100	50	5	30820122	Measurement & Measuring Instruments.	PR-II	3 hrs	100	50	6	30820123	Basic Electrical, Electronics & Instrumentation	PR-III	3 hrs	100	50			Total			600	255
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SYLLABUS
Theory & Practical - I
Basic Engineering Skill & Computer Skill
 Part - I
Basic Engginnering Skill

Theory	Practical
<p>Introduction to Institution, Vocations trade running in the Institute, Introduction to the Scheme of Excellency, Sector Instrumentation, Its Knowledge and scope of employability. Measuring Units & System of Units, MKS, & SI Unit System, Concept of Least Count</p>	<p>Visit to Institute, Visit to Manufacturing / Deep Implementation/Application Industry involved in the Field of Instrumentation. Practice of Use of General Instrument used for measuring Mass/ Weight, Length, & Time, Vernier caliper, Micro meter, Speedometer, Vernier Height Gauge (All mechanical & Digital</p>
<p>CARPENTRY Hand tools Used in carpentry shop its use & safety rule while use and preventive maintenance. Knowledge to wooden fabrication methods, Their principle and Safety rules Nomenclature and Working Introduction & Application of Machine & Machine Tools Used in wooden , Fabrication & Manufacturing Process Making Drawing, and dimensioning of a gazette, making list of material required with their specification and quantity. Introduction to paints & polish material and preparation of surfaces for above.</p>	<p>Practice of use of Hand Tool used in Carpentry Shop such as Carpentry Push Saw, carpentry pull saw, Tendon Saw, Key hole Saw, Planes, Chisels, Mallets, Hammer, Marking, Dividing & Holding Tools & vices Cutting, Chipping, planning practice and Making of Carpentry Joints such as Lap Joint, Dovetail Joint (Using saw , plane, Firmer Chisel etc) Planning, Grooving, Drilling and Turning of wood, practice on wood using lathe & drill other machine. (or Visit to a wooden furniture manufacturing Industry) Fabrication of a small wooden gazette. Finishing, making surface for painting & polishing, Polishing of above cabinet from outside & painting from inside.</p>
<p>FITTING SHOP Hand tools. Their types, characteristics, Use, Do's & Don's, specification and sizes, Like Files, Calipers, scribes, Vices, Scale, Gauges, Hammers, Pliers, Screw Drivers, Chisels & punches, Hacksaw, Selection of Hacksaw Blades, Various types of Spanners, L & N Keys, Screw drivers etc Introduction to Drilling Machine, types of Drilling Machine, Drill bits & reamers, their</p>	<p>Practice of use of Hand Tool used in fitting Shop such as Hacksaw, Chisels, Files Hammer, Marking , Dividing & Holding Tools & vices, Linear Scale, Tri square, Vernier Caliper, Micrometer, Height Gauge, slip gauge, thread ring/plug gauges, Bevel Protector, Spanners, L & N Keys, Screw drivers , Hacksaws etc Sawing, Chipping, Filling on given MS block according to given size & drawing Practice of Drilling, Chamfering & Tapping on MS block using Drill Machine & Hand Tap & Die set Dismantling and assembling practice. Making of a square punching die for sheet Punching</p>

<p>SHEET METAL SHOP Essential tools used for sheetmetal , Sheet metal operations, measuring, Layout marking, shearing, punching, blanking, piercing, Forming, Bending and Joining Advantages and limitations of sheet metal work at cold process, Brief concept of Hot Process & Operations with machines , Concept of joining of sheets bsolder , Flux, soldering, brazing and welding.</p>	<p>Practice of use of Hand Tool used in sheet metal Shop such as Snip , Square & V Blocks, Chisels, Files Hammer, Marking, Dividing & Holding Tools, sheet & wire gauges Cutting, Bending of Iron Sheet as per development drawing of given object Making of various kinds of joints on the Metal Sheet, Riveting Practice and soldering, brazing practice on joint of sheets. Making of panel or cabinet or Chassis for and as per given drawing.</p>
<p>PLUMBING, WELDING Study & use of Hand Tool used in plumbing shop such as pipe vice, threading die, pipe wrench, Introduction to welding, OXY-ACETYLENE welding material Equipment,Resistance Welding, Arc Welding machine, and composition of welding electrodes, Brief Idea about TIG & MIG Welding Principle of electrolysis, Electrolyte solutions, electrodes, Electrolysis bath tub, Luster, Buffing balls, concept of thickness and quantity of electroplating</p>	
<p>MACHINING Lathe Machine, Its Accessories and attachments, types of chucks, lathe center and study</p>	<p>Identifying of parts & understanding of working application of lathe machine and Instrument Lathe machine</p>
<p>Various Lathe operations: speed, feed, and depth of cut, types of cutting tools. Cutting angles</p>	<p>Practice clamping of job, centering it, setting of turning tool, Plane, step and taper turning practice on lathe and instrument lathe machine/Instrument Lathe machine</p>
<p>Threading & Knurling tools and their method to use. Working of Shaper Machine and its application, Dos & Don'ts</p>	<p>Grooving, Drilling, Boring, Threading, Knurling practice on lathe. Practice of making various different shaped MS jobs using Shaper machine</p>
<p>Various milling machine operation type of cutters types of milling machine</p>	<p>Practice on use of various of cutters on milling machine, Straddle milling, gang milling, climb and conventional milling, helical milling, Indexing and gear cutting on milling machine,</p>
<p>Working principle & operation of surface grinder and cylindrical grinder</p>	<p>All Grinding operation for Surface grinding, cylindrical grinding and adverse grinding, grinding of tools and cutters</p>

<p>Basic concept & operation on CNC TECHNOLOGY, NC, CNC, DNC, CAD-CAM, FMS, CIM as a system working programming, Coordinate system, address command G and M modes, standard and canned cycles, Programming Examples Importance of CNC machine over main production process. Construction detail of CNC mechanism Etc. CNC drivers, servo motors encoders (Absolute and incremental) liner& rotary motion system (LMS&RMS), Techno generators, revolvers</p>	<p>*Demonstration of CNC m/c special constructional and operating feature with reference to driving mechanism, machine tool. Example the use of computer as CNC workstation. Communication between hardware and software. Familiarization with co ordinates system. Demo and explanation of CNC machine feature such as-</p> <ol style="list-style-type: none"> 1. Axis driving element, servo motor, gear box, ball screw, position feedback, open loop. 2. Maintenance card, history card and recording the data. Reading and analyzing of CNC alarm message during machine operation. 3. Mounting of rotary encoder and linear optical scale on the axis. Accuracy and performing of CNC machine, problem and remedies
<p>Introduction to die casting, gravity die casting, main parts of casting machine, main parts of die, parting line runners, gates, vents, ejectors, cores, shrinking, cooling method, location, die materials, casting materials.</p>	<p>Visit to Industry to study various casting processes Practice on operations for bending & cutting using bending & cutting Dies Workbench training on assembly of press tools, moulds, Jig & Fixture</p>
<p>Plastic Technology Source and chemical molecular structure of plastic material, monomers, polymers, co polymers, thermoplastic and thermo settings, amorphous and crystalline plastics, plastic processing techniques, post processing treatments. Moulds: Injunction moulds and molding, Main parts, runner, gates, parting lines, ejection, ejectors, return mechanism, undercuts,, sliders,, splits and moulds,, molding of threaded components, mould cooling,, three plate moulds, toollocation and guide system, ventilation in moulds</p>	<p>Practice on making various kinds of moulds, machining of moulds, matching of bearing faces, adjustments of sliders, polishing of moulds Practice on Plastic processing techniques, observe & control behavior of plastic during hot processing, Post processing treatments & Precautions</p>

Part - II

Basic Computer Skill

Practical	Theory
<p>Demo of working of Computer, demo of input and out put devices, their features, handling and handling precautions, Identify external ports and connectors; identify types of connectors and interconnections, practice removing and interconnecting. Floppy drive and storage media. CD Rom drive, media and usage, Mouse, Scanners, Printers</p>	<p>Introduction to Computers, What is Computer, History, Classification and various use of computers. Characteristics of Computer, Basic construction and working of Digital computer, Concepts of input and output devices and their ports, types of ports used in PC, identification tips and techniques, Various types of Input, Output, devices & printers: DMP, Inkjet, Color Laser Printer, & plotter. , Concept of memories & Storage Devices, Networking Devices</p>
<p>Features of Windows as an operating system</p> <ul style="list-style-type: none"> •Start & Shutdown •Creating and operating On the icons •Opening closing and sizing the windows •Using elementary job commands like- creating, saving, modifying, renaming, finding and deleting a file •Creating and operating on a folder •Changing setting like, date, time color (back ground , Screen saver etc) •Using short cuts •Using on line help 	<p>Software, types of software, Concept of Operating System, Single User, Multi user Operating Systems, DOS, Windows, Networking environment, Concept of LAN & VAN, Application Software & package Software, Concept of Driver Software, Installing And Uninstalling Drivers. Starting and shutting down PC. Identify computers on desktop. Identify drives and capacity. Creation folders on Desktop and drive using windows & DOS Basic internal & main external Dos Commands</p> <p>Virus and ant virus programs types and symptoms.</p>
<p>MS WORD</p> <ul style="list-style-type: none"> •File management: •Opening, creating and saving a document, locating files, Copying contents in some different file (s), protecting files, Giving password protection for a file •Page Set up: •Setting margins, tab setting, ruler, indenting •Editing a document: Entering text, Cut, Copy, paste 	<p>Various Method of Editing of Documents, Concept of Editing, Formatting, saving, reusing, printing, exporting & Transfer of Documents Concept to text processing, overview of Note Pad, Word Pad, MSWORD, bars and controls, description of options in the file edit and view menu, using short cuts.</p>

<ul style="list-style-type: none"> • Formatting a document: Using different fonts, changing font size and colour, changing the appearance through bold/ italic/ underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods, Aligning of text in a document, justification of document, Inserting bullets and numbering <p>Formatting paragraph, inserting page breaks and column breaks</p> <p>Use of headers, footers: Inserting footnote, end note, use of comments</p> <p>Inserting date, time, special symbols, importing graphic images, drawing tools</p> <ul style="list-style-type: none"> • Tables and Borders: Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table <p>Print preview, zoom, page set up, printing options</p> <ul style="list-style-type: none"> • Using Find, Replace options • Using Tools like: Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelopes and labels 	<p>Concept of preparation of various Documents. Viz. Correspondence, Operation & Service Manuals, Call Reports, Inventory Vouchers, Merging of Documents for mail/email/Fax</p>
<p>MS-EXCEL</p> <p>Starting excel, open Worksheet, enter, edit, Data, formulas to Calculate values, format Data, create chart, printing Chart, save worksheet, Switching from another spread sheet</p> <p>Menu Commands: Create, format charts, organize, manage data, solving problem by analyzing data, exchange with other applications Programming with MS-Excel, getting information while working</p> <p>Work books: Managing work books (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations, working with arrays</p> <p>Editing a worksheet, copying, moving cells, pasting, inserting, delectation cells, rows, columns, find and Creating a chart:</p>	<p>Concept of worksheet Features & limitations of Ms Excel and Parts of A Excel Sheet. Entering and editing Data in Cells of a Excel Sheet. Features of file and edit menu. Using short cuts.</p> <p>Description of feature of inserts and format menu and uses with examples.</p> <p>Concept of BAR CHART< PIE CHART</p> <p>Description of features of tools menu and concept of data table and features of data menu. Examples using multiple worksheet and books</p>

<p>Working with chart types, changing data in chart, formatting a chart, use chart to analyze data Using a list to organize data, sorting and filtering data in list</p> <p>. Customize MS-Excel:</p> <p>How to change view of worksheet, outlining a worksheet, customize workspace, using templates to create default workbooks, protecting workbook</p> <p>Exchange data with other application: linking and embedding, embedding objects, linking to other Practice using multiple worksheet and books and printing of worksheets.</p>	
<p>Internet Log-in to internet , Creating E-mail account, Email Sending and receiving e-mail , Creating a message , Creating an address book, Attaching a file with e-mail message, Use of voice mail and Chatting</p> <p>Surfing/Reading/ Replying/Deleting/ E-mail to multiple recipients. Navigation for information seeking on internet, USE OF various search engine, searching of information, Download, Read, Save net contents, Conversion of format like PDF to Word or other etc. Maintenance of PCs and its Peripherals (Hard Disk, Floppy disk, Anti Virus software, Printer(s))</p>	<p>Concept of Internet, Term used in web Technology, creation of e-mail account, sending and the receiving mails, use of search engine, Net Surfing, on Line Chat and extra use of net like down load, gathering of desired information</p>
<p>Maintenance: Preventive maintenance of Computer Equipment, Concept of loading of Operating System, Software Drivers for Mother Board, Auxiliary input and output devices and peripherals.</p>	<p>Practice of connecting of input and output devices such as Floppy Drive, Storage Disk, CD Drives, Scanner, Printer, Key Board Mouse, etc. Practice loading of drivers and operating System.</p>

List of Tools

S.No.	Tool Kit	Quantity
1.	Rule steel 15 cms	10Nos.
2.	Square try 10 cm blade	
3.	Caliper outside 15 cms spring	
4.	Caliper inside 15 cms spring	
5.	Divider 15 cms spring	
6.	Scriber 15 cms	
7.	Punch center 10 cms	
8.	Chisel cold 19 mm	
9.	Hammer Ball pein 0.22 kg with handle	
10	File flat 25 cm second cut	
11.	File flat 25 cm smooth	
12.	Hacksaw frame adjustable 20-30 cm	
13.	Pad saw with 3 blades	
TOOLS INSTRUMENTS AND GENERAL SHOP OUTFIT		
1.	Rule steel 30 cms	8 Nos.
2.	Mallet wooden 0.66 Kg.	
3.	Soldering copper 0.27 Kg	
4.	Crosspein hammer 0.22 kg.	
5.	Steel tape 2 mts	
6.	Rule, four fold wooden 600 mm	
7.	Marking knife	
8.	Screw driver 300 mm	
9.	Square try 200 mm	
10.	Saw, hand 450 mm	
11.	Saw tenon 300 mm	
12	Chisel firmer 12 mm to 22 mm by 2mm - 5 each	
13.	Hammer, cross pein carpenter 600 gms with handle	
14.	Plane jack 450 mm wooden stock 50 mm cutter	
15.	Chisel mortise 3 mm to 20 mm by 2mm - 5 each	
16.	Gauge mortise and marking	
17.	Stonc oil 150 mm x 20 mm x 25mm	
18.	Centre punch	
19.	Straight edge 46 cm steel	4 Nos.
20.	Plate surface 45 x 45 cms	4 Nos.
21.	Key Hole saw	4 Nos.
22.	Carpenter vices	4 Nos.
23.	Firmer chisel (different sizes)	8 Nos.
24.	Universal scrumbling block	4 Nos.
25.	Drill brace hand 0 to 12mm	8 Nos.
26.	Drill twist s/s 1.5 mm to 12mm by 0.4(1 each)	4 Nos.
27.	Taps and dies complete set in BA	2 Nos.
28.	Taps and dies complete set up to 15 mm by .5 mm in Metric	1 each
29.	Taps and dies complete set in with worth	2 Nos.
30.	File round 30 cm bastard	4 Nos.
31.	Stone, Carborandum 15 cm x 5 cm x 4 cm	08 Nos.

32.	File flat 30 cm 2 nd cut	4 Nos.
33.	Can oil 0.25litre	4 Nos.
34.	Clamp "c" 5 mc	4 Nos.
35.	Chisel cold 19 mm flat	4 Nos.
36.	Drill chuck 12 mm	4 Nos.
37.	Pipe vice no.4	4 Nos.
38.	Vice bench 12 mm jaw	4 Nos.
39.	Bench working 240 x 120 x 60cm	4 Nos.
40.	Almirah 180 x 40 x 30 cm	4 Nos.
41.	Lockers with standard 10 drawers	2 Nos.
42.	Metal rack 182 cm x 182cm x 45 cm	2 Nos.
43.	Desk	As required
44.	Table and Chair for Instructor	2 Nos.
45.	Fire brackets	2 Nos.
46.	Trammel	1 No.
47.	Clamp 150 mm set	08 Nos.
48.	Plane, trying 75 mm	08 Nos.
49.	Plane, rebate adjustable	8 Nos.
50.	File rasp bastard 250 mm	08 Nos.
51.	Ratchet brace 250 mm	8 Nos.
52.	Bit center 6,8,10& 12 mm	4 Nos.
53.	Auger 12,16,20,22 & 25 mm	4 Nos.
54.	Gouge, firmer 6,10,12 & 15 mm	4 Nos.
55.	Timmons square 45 cm x 60 cm	4 Nos.
56.	Standard sheet metal gauge	08 Nos.
57.	Stake hatchet	08 Nos.
58.	Stake round and bottom	8 Nos.
59.	Stake funnel	4 Nos.
60.	Anvil face 12 cm x 7 cm	4 Nos.
61.	Bick iron	4 Nos.
62.	Horse stake	2 Nos.
63.	Hammer creasing	8 Nos.
64.	Hammer Planishing	8 Nos.
65.	Sheer tin-man's 25 cm	08 Nos.
66.	Snip straight 20 cm	08 Nos.
67.	Snip bent 20 cm	8 Nos.
68.	Rivet set and snap combined 4 mm	8 Nos.
69.	Chisel cold, flat 25 mm	8 Nos.
70.	Combination plier insulated	4 Nos.
71.	Nose plier	4 Nos.
72.	Clamping & crimpling plier	4 Nos.
73.	Cock plier adjustable	4 Nos.
74.	Grover 4 mm	2 Nos.
75.	Soldering iron 425 gm	2 Nos.
76.	Hammer raising 0.45 Kg	2 Nos.
77.	Filler gauge	2 Nos.
78.	Vernier Callipers	08 Nos.

TOOLS/INSTRUMENTS AND	
1	Steel Rule 60 cms
2	Screw Driver 300 mm
3	Square Try 200 mm
4	Taps & Dies Complete set in b A
5	Taps & Dies in Metric 3mm /15mm (steps in 1mm)
6	Drill Twist SS 3mm to 25 mm by 1mm
7	Taps & Dies complete set in whit worth
8	File round 30 cm bastard
9	File flat 30 cm 2 nd cut
10	Drill chuck 12mm
11	Vice Bench 12mm jaw
12	Working Bench 240 x 120 x 60 cm
13	Lockers with standard 10 drawers
14	Almirah 180 x 40 x 30 cm
15	Desk & Bench
16	Table with chair for Instructor
17	Hammer raising 0.45 Kg
18	Filler Gauge
19	Vernier Callipers
20	Screw Gauge
21	Depth gauge
22	Chizzel cold
23	Ball Pein Hammer 500gms
24	Combination Plier
25	Clock Plier
26	Nose Plier
27	Bevel Protector
28	Double Ended Spanner Set
29	Box Spanner Set
30	Allen Key set
31	Allen Key Set (Miniature)

S.No	Name of Item	Quantity
1.	Computer Tables (With atleast one draw with lock)	As required.
2.	Computer Operator Chairs	10 Nos.
3.	Printer table	As required
4.	Book Case and Almirah	As required
5.	Instructor table & chair	1 No.
6.	Multimedia Projector	1 No.
7.	PC of configuration P-IV or equivalent with multimedia kit internet cards and preloaded Win 2000/Win XP operating system (with MB manual and CD) with UPS	10 Nos.
8.	Microsoft Office package (Office 2000 or Office XP)	As required
9.	Antivirus software	As required.
10.	Table top Scanner	1 No.
11.	Laser Jet Printer (Mono)	2 Nos.
12.	Inkjet/Deskjet column printer	1 No.
13.	Web Camera	1 Nos.
14.	16 Port Switch	1 No.
15.	Crimping tool for RJ 45/RJ11	1 No.
16.	Modern external and internal	1 External and 1 Internal

Theory - II

Measurement & Measuring Instrumentation

Theory & Practical
<p>System of Units and Basic Measurement :</p> <p>Fundamental & Derived Units, Length, mass, Time & temperature Measurement, Accuracy & Precision of Measuring Instruments, Error in Measurements, Significant Figures, Revision of definition of physical quantities and their mathematical relation to other quantities, Dimensions of Physical quantities, Dimensional analysis and its applications, their SI units, Theory of errors: Accuracy & Precision, Repeatability & reproductability, Limits of Errors, Systematic & Random error, Gaussian error analysis, combination of errors, sensitivity, threshold, drift</p>
<p>Velocity Measurement Measurement of Linear velocity,, mechanical tachometer, Electrical tachometer, stroboscope and stroboscopic method of instruments of angular velocity, Measurement of Vibrations, Accelerometer and their types</p>
<p>Pressure Measurement: What is pressure, Theory of Pressure: What's ressure, absolute pressure, atmospheric pressure, differential pressure, elastic pressure, pressure unit, Bourdon tube pressure gauge its principle construction , working and operation, Spiral & helical bourdon tube pressure gauge, force balance pressure gauge, Piston type, bell type and ring type pressure gauge, Diaphragm and capsule type pressure.. Working principle and construction including dead weight tester.Electrical pressure transducers, potentiometer pressure transacted capacitive pressure</p>
<p>Specific Gravity & Viscosity:</p> <p>Definition of density, specific gravity, Hydrometers density of gases meriting orifices, impulse wheel method, specific gravity system & instrument, turbulent flow viscosity, density and velocity Reynolds number and Bernoulli's theorem. Flow: Introduction to flow Theory of flow, description about, stream flow, measurement of pH and conductivity, flow measuring techniques, and flow measurement methods, variable head flow meters, Differential pressure flow meter, Orifice plates, Ventura Tubes, Flow nozzles, Pitot tubes, and Rota meters. Electromagnetic and ultrasonic flow meters, Vortex flow meters, Mass flow type meters. Shunt flow meters.</p> <p>Level: Float type, Displacement type, Hydrostatic type, Diaphragm type, Differential pressure method, Electrical conductivity method, Capacitance level, Ultrasonic and nucleonic gauges, Capacitance Probes, Solid level detectors. Air type level measuring instrument Working principles and construction Displacement and capacitor type level instruments Description and use of "U" tube monometer well type and inclined</p>
<p>Thermal & Temperature Temp, Scales, resistance thermometry, General purpose thermo couples, J/K/R/S & PT-100(RTD) etc, Mineral Insulated Thermo couples, principle of thermocouples. PTC/NTC Thermostats, & Principle working, operation and testing of Bimetallic thermometer. Construction of Moving coil pyrometer. Construction, repairing and testing. Resistance thermometer. definition, of pyrometer, Optical pyrometers, principle, Construction operation of different types, Radiation pyrometer principle and operation Factors governing the operation of A.T.C. Compensating leads, necessity of compensating leads its material. Cold junction compensation necessity and types. Construction, repairing and testing of Potentiometer pyrometer</p>

Strain Measurements: Electrical strain gauges wire & foil type materials, Adhesives configuration, Protective coatings, Bonding, Temp. Compensation, calibration, Applications Renaissance gauges. Sensors : Proximity sensors, Photo electric Sensors, plug type sensors, univocal, bipolar, techo, leno, liner, FD, Button, Square, level sensors, float type of sensors, Inductive, Capacitive, optical, & Magnetic Proximity sensors Magnetic Float switches & Reed Switches

Basics of Control systems, block diagram of Functional elements & their types, Open loop/Closed loop, concept of feed back, Transfer function, PID, gain margin stability,, Single point temperature controller & multi point controller. Familiarization with Environmental pollution monitoring system: Air pollution monitoring instrument-carbon monoxide, sulphuric oxide, nitrogen dioxide, hydrocarbon and ozone. Smoke monitor, dust monitor, visible emission monitoring system Indicator, Recorders and controllers : Single point indicator, multi point indicator, analog and
Recorders : Analog recorders, digital recorder, operating mechanism, strip charge recorders, circular recorders, x-y recorders, single point, multipoint recorders,
DATA LOGGERS, data acquisition system, supervisory control system, direct digital control, concept of programmable logic control(PLC

List of Tools

Sr. No.	Name of Tool & equipment	Qty.
1.	Screw Drivers 100mm	10 Nos.
2.	Screw Drivers 150 mm	10 Nos.
3.	Screw Drivers 300mm	10 Nos.
4.	Screw Drivers Heavy Duty	10 Nos.
5.	Screw Drivers Star Type	10 Nos.
6.	Screw Drivers Set	10 Nos.
7.	Screw Driver Set Philips Type	10 Nos.
8.	Neon Tester	10 Nos.
9.	Caliper out side 15 Cm	2 Nos.
10.	Caliper Inside	2 Nos.
11.	Divider Inside	2 Nos.
12.	Scriber 15 Cm	2 Nos.
13.	Vernier Caliper	10 Nos.
14.	Micro meter	10 Nos.
15.	Spherometer	10 Nos.
16.	Vernier Height Gauge	2 Nos.
17.	Bevel protractor	2 Nos.
18.	Combination Pliers	10 Nos.
19.	Long Nose Pliers,	10 Nos.
20.	Side Cutting Pliers	10 Nos.
21.	Wire Stripers	10 Nos.
22.	Crimping and Clamping Pliers	8 Nos.
23.	Hand Drill machine	8 Nos.
24.	Motorized portable drill machine	4 Nos.
25.	Drill bit set (sizes as required)	4 Nos.
26.	Hammer ball pein 0.250 Kg	4 Nos.
27.	Hammer ball pein 0.500 Kg	4 Nos.
28.	Hammer cross pein 0.250 kg	4 Nos.
29.	Hack Saw frame 200mm	8 Nos.
30.	Steel Rule 30 Cm	4 Nos.
31.	Files Flat 2nd Cut 150mm & 300mm	08 Nos.
32.	File Flat Smooth 150 mm & 300 mm	08 Nos.
33.	File Round smooth	2 Nos.
34.	File Half Round Smooth	2 Nos.
35.	File Half Round 2nd Cut	2 Nos.
36.	File Half Round 2nd cut	2 Nos.
37.	Steel Rule & Steel tape	15 Nos.
38.	Can oil 0.25 Lts	2 Nos.
39.	Can oil 0.5 Lts	2 Nos.
40.	Chisel Cold 19mm flat	2 Nos.

Theory & Practical – III

Basic Electrical, Electronics & Instrumentation

Theory	Practical
<p>Safety Precaution and first aid, Care & Maintenance of hand tools. Basic atomic structure Electro emission classification of materials e.g. Conductors, semiconductors and Insulator Types, grade and sizes of insulated wires and cables, their proper selection and use. Introduction to Hand tools their use, operation and safety precautions</p> <p>Different types of solders fluxes and their proper use. Introduction to the equipments used for soldering and crimping, care & maintenance on Soldering & Crimping equipments, Specification to common electrical accessories, Letters sign and symbols used in electrical technology Electrical accessories used in house / Lab/ workshop wiring, their Specification. Wiring concept, simple house wiring circuits, Stair case, godown wiring Ckts, Brief Idea about control panel wiring, Main Board wiring, Use of Fuses, cutouts, Miniature Ckt Breakers</p>	<p>Basics of electricity, electrical shock, Electrical safety, Familiarization with the safety tools and equipments.</p> <p>Demonstration of safety equipments. Identifications various kinds of insulated & non insulated and enameled Wires, Practice on use Do's & Don'ts with hand tools used in Electrical Labs, Like Line Tester, Screw drivers, Electrical Knife, Holding Pliers, Cutting pliers, Insulation Nippers, Saws, Chisel, Hand Drilling Machine</p> <p>Practice of Making Different types of joints e.g. Britannia, Straight, Tee, Western union. Care in making a good joint on copper aluminum wires and cables.</p> <p>Practice of Crimping and Clamping of thimbles & Connectors.</p> <p>Practice of Soldering of Electric joints.</p> <p>Practice of Making of Simple House wiring Circuits, Controlling of one & more Points from Single and multiple places</p> <p>Making of Series testing & multiple socket extension board .</p>
<p>Electrolysis and laws of electrolysis, primary and secondary cell, construction and working of dry cell, standard cell, lead acid battery, Ni-Cd battery, Alkaline batteries, common defects in cells and batteries and their remedies, care and preventive maintenance.</p> <p>Ohm's law and its application, concept of series, parallel and mixed circuits, identification of AC and DC meters, Resistance, Specific Resistance, Conductivity and Resistivity, laws of resistance, Kickoff's law and their application, Wheatstone bridge, types of resistances and concept of resistance color code</p>	<p>Effective usage of measuring equipments like current and voltage meters of DC supply measure of resistance millimeters. Grouping of Cells in series & Parallel Identification of various kinds of cells & batteries Lead acid batteries, its care and maintenance Making of Circuit connection for verification of ohm' law</p> <p>Making of connections for various grouping of Resistances measurement of separate, grouped & cumulative Resistance, Current, & Voltage in the mash</p> <p>Practice on use of equipments made on principle of Wheatstone bridge</p>
<p>Effective usage of measuring equipments like current and voltage meters of DC supply measure of resistance millimeters. Grouping of Cells in series & Parallel Identification of various kinds of cells & batteries Lead acid</p>	<p>Tracing the Field of Bar magnet, Horse Shoe magnet, finding of magnetic strength, Tracing the Field Combined effect of two magnet with same & opposite polarity, Tracing the magnet field set up by a current</p>

<p>batteries, its care and maintenance Making of Circuit connection for verification of ohm' law Making of connections for various grouping of Resistances measurement of separate, grouped & cumulative Resistance, Current, & Voltage in the mash Practice on use of equipments made on principle of Wheatstone bridge</p>	<p>carrying conductor, and a loop, Making of simple electro magnet, measuring of its field strength & tracing of magnetic field Finding the permeability of iron, making of a electromagnetic over load relay Measure AC quantities like voltage, current. Measurement of frequency. Measure AC power & power-factor. Measure electrical power (single-phase and 3-) power and energy. Energy meter, watt-hour meter. power (single-phase and 3-phase) power and energy. Energy meter, watt-hour meter.</p>
<p>Application of electromagnetic induction, Transformer principle , construction and working of Transformer, classification and types of transformer, Mathematical terms and formulas used in transformer, Principle of working of instrument transformer (CT, VT)Electrica measurement: Introduction to instrument, absolute and secondary instrument, Analog and Digital Instrument ,Indicating Instrument, operating forces, construction and details ,types of support & balancing , torque weight ratio, control System, comparison between spring and gravity control, damping system and types of damping, damping torque of metal disc, pointers and scale , symbol used for analog instruments-nature omeas ured quantities and number of measuring elements, safety, accuracy class, principle of operation, Recording Instrument Integrating Instrument, pointer and scale , concept of accuracy and error</p>	<p>Preparation of former for different types of coils and tapping, practice on that Making of bobbins, cutting of laminations lining by leatheroide paper and cloth etc. Winding of step down Transformer</p> <ol style="list-style-type: none"> 1. Demonstration of Large size Cut Model of Basic Instrument & study of Basic forces and effect utilized Basic force acting on indicating instrument and effects utilized in different types of instruments. 2. Demonstration of Dismantling, showing of each part of basic Instruments and re assembling, Dismantling Assembling, Repairing of moving parts of instruments-, Fault finding, replacement of parts and adjustments.
<p>Principle and construction working of Galvanometers, Types of galvanometer and their construction, working, analog Ammeters, Voltmeter and Ohmmeter , , construction , working of PMMC type instrument, Ammeter Shunt, sensitivity of PMMC instrument, conversion of PMMC into Voltmeter, series and shunt type ohmmeter, multi VOM meter Principle, construction, working of moving iron instrument. Classification of moving iron instrument, concept of shunt and multiplier for moving iron instrument, comparison o Attraction and Repulsion type instrument,</p>	<ol style="list-style-type: none"> 1. Seeing of, construction and operation of Permanente magnet moving coil instruments. 2. Seeing of, construction and operation of various types of Galvanometers. 3. Dismantling Assembling, Repairing of moving coil instrument Fault finding replacing of paste and adjustments. 4. Calibration of Moving Coil, instruments, Methods of calibration, preparation of error cards and designing

<p>errors , advantage and disadvantage of moving iron instrument Construction , working , error advantage and disadvantage of Electrodynamo meter instrument, electrodynameometer type wattmeter, Thermocouple Wattmeter, Hall effect, construction, Motor type meters, Energy meter instruments</p>	<p>of simple testers.</p> <p>5. Voltmeters and multi-voltmeters, how the current meter is converted into voltmeter-calculation of series resistance and use of multipliers for extension of voltmeter range.</p> <p>7 Moving Iron instruments, purpose, construction and operation of moving iron</p> <p>8 VOM, Working principle, method of use volt-ohm , milli ampere meter</p> <p>11 Dynamometer Instrument, Principle, connection and operation of dynamometer instruments.</p> <p>12 Hot wire instrument, principle, purpose and construction of hot wire instruments. Thermocouple and rectifier type instrument, principles, purpose, construction and operation of thermocouple and rectifier type instruments.</p> <p>13 Suppressed zero and long scale instruments</p> <p>14 Meggers principle, construction and operation of meggers, measurement of earth to line resistance using megger</p> <p>15 Construction of Kilowatt hour meter. Connect and operate kilo watt hour meter,</p> <p>16 Construction of Latest Pilferage free KWH meter</p>
<p>Single phase motor:- Principle Construction and working of Single phase Induction motors, Types, construction working of single phase motor , capacitor motors, universal motors, shaded pole motors & repulsion motor, their characteristics, advantage, care and maintenance, fault and remedies Winding:-Insulating material used in winding, classifications characteristics, types of varnish, methods of impregnation, terminology in motor winding procedure and important points. Types of coils used in motor winding types of ac winding DC motor construction and types, winding single layer and double layer winding calculation and preparation of winding data testing.</p> <p>Micro motors, stepper motors, DC motor</p>	<p>Familiarization with parts construction of capacitor start induction run, capacitor start capacitor run split phase induction run, repulsion start induction run motor repulsion start repulsion run motors and run the motors.</p> <p>Trace out the circuit diagram carry out the insulation test repair and, maintenance of single phase motors</p> <p>Dismantling of burnt single Phase Electric motor, Overhauling of the parts and Rewinding of the Burnt motor, use of Insulation Paper, varnishing of winding, Reassembling, Alignment of armature.</p>

List of Tools

S No	Name of Tool & equipment	Qty
1.	Screw Drivers 100mm	10 Nos.
2.	Screw Drivers 150 mm	10 Nos.
3.	Screw Drivers 300mm	10 Nos.
4.	Screw Drivers Heavy Duty	10 Nos.
5.	Screw Drivers Star Type	10 Nos.
6.	Screw Drivers Set	10 Nos.
7.	Screw Driver Set Philips Type	10 Nos.
8.	Neon Tester	10 Nos.
9.	Combination Pliers	10 Nos.
10.	Long Nose Pliers,	10 Nos.
11.	Side Cutting Pliers	10 Nos.
12.	Wire Stripers	10 Nos.
13.	Crimping and Clamping Pliers	8 Nos.
14.	Hand Drill machine	8 Nos.
15.	Motorized portable drill machine	4 Nos.
16.	Drill bit set	4 Nos.
17.	Hammer ball pein 0.250 Kg	4 Nos.
18.	Hammer ball pein 0.500 Kg	4 Nos.
19.	Hammer cross pein 0.250 kg	4 Nos.
20.	Hack Saw frame 200mm	8 Nos.
21.	Soldering Iron 15W	08 Nos.
22.	Soldering Iron 30W	08 Nos.
23.	Soldering Iron 65W	4 Nos.
24.	Soldering Gun 250 W	4 Nos.
25.	Temperature Control Soldering & Desoldering Station 15W	4 Nos.
26.	SMD Soldering Desoldering Stations with accessories	4 Nos.
27.	Files Flat 2nd Cut 150mm & 300mm	4 Nos.
28.	File Flat Smooth 150 mm & 300 mm	4 Nos.
29.	Snip Straight	4 Nos.
30.	Snip Curved	4 Nos.
31.	Steel Rule & Steel tape	4 Nos.
34.	Double ended and Box spanners set	2 Each
35.	Moving Iron Volt meters diff ranges 0-10, 50, 100, 300,	2 Each
36.	Moving Coil Volt meters 0-1, 5, 10, 30, 100, 300v (Ac)	2 Each
37.	Moving Coil Volt meters 0-1, 5, 10, 30, 100, 300v (Ac)	2 Each
38.	Moving Iron Ampere meters 0-1,2,5,10,20 Amp	2 Each
39.	Moving Coil Volt meters 0-1, 5, 10, 30, 100, 300v (Ac)	2 Each
40.	Moving Coil Amp meters 0-100ma, 500ma, 1, 5, 10, Amp (Ac)	2 Each
41.	Moving Coil Amp meters 0-100ma, 500ma, 1, 5, 10, Amp DC)	2 Nos.

42.	Tong tester with all Voltage current and continuity testing	4 Nos.
43.	Brad Board with + 5v, +12 V Power supply, & pulse generator	8 Nos.
44.	Singe phase Wattmeter 230v 5kVA	4 Nos.
45.	Megger	2 Nos.
46.	Earth tester	2 Nos.
47.	Analog Multimeter	4 Nos.
48.	Digital Multimeter 3 -1/2 Digit	8 Nos.
49.	Digital Multimeter 4 -1/2 Digit with capacitance, inductance, frequency and db, temperature Measurement facility	4 Nos.
50.	LCR Bridge	4 Nos.
51.	Digital LCR meter	4 Nos.
52.	Function Generator	6 Nos.
53.	CRO 10 MHz	4 Nos.
54.	CRO 20 MHz Dual Trace	2 Nos.
55.	Storage Oscilloscope 100 MHz	2 Nos.
56.	AF & RF Signal Generator	4 Nos.
57.	AF Power Out put meter	2 Nos.
58.	Dc Regulate Power Supply 0-30 V 1A	8 Nos.
59.	Dc Regulate Power Supply 0-30 V 2A	8 Nos.
60.	SMPS Based Regulated Power Supply	8 Nos.
61.	Inverter 1 KVA	4 Nos.
62.	UPS off line 750 VA	6 Nos.
63.	Voltage Stabilizers 2 KVA	4 Nos.
64.	LEAD ACID Batteries 120 AH	As Reqd
65.	Battery Charger SCR/ MOSFET based 6A with protections	6 Nos.
66.	Transistor Tester	4 Nos.
67.	Distortion Factor meter	4 Nos.
68.	Digital Experiment Trainer Kit (combined)	8 Nos.
69.	Digital Logic gate Trainer Kit	8 Nos.
70.	Digital IC Tester	4 Nos.
71.	In Circuit Digital IC Tester	2 Nos.
72.	Analog IC Trainer Kit	6 Nos.
73.	8085 /8086 Micro processor trainer Kit with Application interface facility	4 Nos.
74.	EPROM Program Programmer Kit & EPROM eraser	4 Nos.
75.	LVDT Trainer Kit with accessories	4 Nos.
76.	Pressure Transducer Trainer Kit and measurement system using strain gauge and piezo electric sensor	2 Nos.
77.	Load Cell Kit	2 Nos.
78.	Characteristics cum trainer Kit for Diodes , BJT, UJT, JFET, MOSFEEET, SCR, DIAC, TRIAC	As Reqd.
79.	Characteristics cum trainer Kit for Amplifiers	As Reqd.
80.	Characteristics cum trainer Kit for Oscillators	As Reqd.
81.	Decade resistance box	4 Nos.