MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI - 51

1	Name of Course	**CERTIFICATE COURSE IN FABRICATION (FITTING & WELDING) (303210) (w.e.f. 2018-19)**
2	Max. Nos. of Student	25 Students
3	Duration	1 Year
4	Type	Part 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.
9	Objective Of Syllabus/ introduction	Awareness of Safety precautions Knowledge of Engineering skill, use of tools in assembly Awareness of Electronics & Computer Skill. Awareness of Basic Sheet metal work & Fastening. Awareness of Machine shop Practice (Turning, Milling & Grinding). Awareness of Basic Welding. Awareness of Metals & Surface Finishing Technique.
10	Employment Opportunity	The trainee will either to be able to take up jobs with agencies which maintain and repair Fabrication (Fitting & Welding) or with working experience will be in a position to start his own independent Business.
11	Teacher's Qualification	Diploma in Mechanical/Fabrication Engg.
12	Training System	**Training System Per Week** Theory: 6 hrs; Practical: 18 hrs; Total: 24 hrs
13	Exam. System	

Sr. No.	Paper Code	Name of Subject	TH/PR	Hours	Max. Marks	Min. Marks
1	**30321011**	Basic Engineering, Electrical, Electronics & Computer Skill.	TH-I	3 hrs	100	35
2	**30321012**	Basic Sheet metal work, Fastening, Welding.	TH-II	3 hrs	100	35
3	**30321013**	Basic Machine shop Practice, Metals & Surface Finishing Technique.	TH-III	3 hrs	100	35
4	**30321021**	Basic Engineering, Electrical, Electronics & Computer Skill.	PR-I	3 hrs	100	50
5	**30321022**	Basic Sheet metal work, Fastening, Welding.	PR-II	3 hrs	100	50
6	**30321023**	Basic Machine shop Practice, Metals & Surface Finishing Technique.	PR-III	3 hrs	100	50
		TOTAL			**600**	**255**

SYLLABUS

Theory & Practical – I

Basic Engineering, Electrical, Electronics & Computer Skill.

Practical	Theory
- Demonstration of use of Safety equipments and artificial respiration. - Use of hand tools. Joining Practice with single and multi-stand conductors of different wires. - Joining practice of bare conductors - Soldering Practice on Printed circuit boards - Demonstration & practice on soldering the Aluminium conductor, cable joints. Use of Aluminium flux and Alca 'P' solder. Demonstration and practice of crimping of various wires	- Importance of Safety- Description, specification, general care & maintenance of common hand tools - Wires & cables - conductors, Insulators & semiconductors - their shapes, sizes with respect to low, medium & high voltage - Soldering Printed circuit boards & its uses - Different fluxes for different purposes on metals- Crimping equipment - Joining of conductors by soldering - Importance of Preventive Maintenance and routine tests - Earthing and its importance.
- Making of a simple circuit with a lamp and battery - Study and use of Multi meters - measurement of current, voltage, resistance in DC / AC circuits - Demonstration & verification of ohm's law - Series circuits - Parallel circuits - Demonstration & Practice on connecting & replacement of common electrical accessories in circuits – Use of tong tester and megger.	- Resistance, Voltage, Current, open circuit and short circuits- Ohm's law - Voltage drop - series & parallel circuits - Power & energy relations - Electrical measuring Instruments – Multi-meters - Common electrical accessories used in Industries - Bus-bars, Relays, Contactors, Circuit Breakers, etc.. - Fuses and its ratings – materials used
- Simple wiring practice with distribution boards, Junction Boxes, Main Switches two way and intermediate Switches.	- Induction principles - Electro-magnetism - Faraday's Laws - Single phase & Poly phase system 3 phase star-delta
- Identification of different parts of DC generators- testing and measuring the field and Armature resistances - Identification of different parts of AC Motors - Testing and measurement on Induction motors - Demonstration on Alternators . - Identification and testing of transformers. - Grouping & testing of cells for a specified voltage & current - Preparation of battery charging	connections, Impedance & power factor – - Principles & Applications of DC Motors , Series, Shunt & compound motor – AC Motors - Transformers & its applications - Chemical effect of electric current - Rechargeable batteries - Care & maintenance of cells - AC Motor starting with DOL Starter and Star - Delta Starter

- Identification of different type of capacitors - Testing of capacitors - Identification and Testing of assorted diodes, PNP/NPN Transistors - Uni - junction Transistor, Field effect Transistor & Silicon Controlled Rectifier ICs etc. - Demonstration on Rectifiers - Identification of ICs	- Static Electricity - Capacitors & its applications - Fundamentals of a electron theory - semiconductor devices - Symbols - specifications - Diodes, Transistors, Uni-junction Transistor, Field effect Transistor Silicon Controlled Rectifier & ICs. - Half wave, full wave & Bridge rectifier with filters, DC Power supply
Booting The Computer , Opening Windows Menus, using the mouse, refresh computer desktop using right click of the mouse, create a directory in xp and linux, format a floppy, create a file using notepad, save the file in Floppy, copy the file into hard disk, copy a file from hard disk to floppy, create a directory in floppy, create a directory in hard disk, use my documents, use start menu for opening an application, to open a document recently written, change control panel settings for display, change the volume name of the hard disks using system properties., Familiarise with Keyboard and Keys.	Introduction To Computer Fundamentals And Its Parts, Familiarising With Disk Drives, Booting Of A Computer System, Using The Mouse, Right Click, Left Click And Use Of Operating Systems Like Windows XP, Linux , Menu System, Tool Bars, File Structures, Directories, Moving And Copying A File From Floppy To Hard Disk, Hard Disk To Floppy Disk, Creating Directories. Formatting Floppy Disk.
Techniques of Changing desktop wall paper, changing Desktop Screen properties, Control Panel , User Accounts, customizing icons, writing a sample text using Notepad, Using Paint for drawing figures to get accustomed with mouse. Saving a file. Using Windows Explorer, Install a software, Remove a Software, Add new hardware to the system (like a Printer, Change the system date and Time, changing the Regional Settings of the system like country, Currency, Date Format, Using Start Menu, Creating Desktop Short Cuts	Use of desktop , control panel settings, Explorer, regional settings, creating shortcuts, Use of Simple applications like Paint, Notepad,

List of Tools

Sr.No.	Item	Qty.
1.	Steel rule 30 cm graduated both in English & Metric units	10 Nos.
2.	Outside spring caliper 150 mm	10 Nos.
3.	Inside spring caliper 150 mm	10 Nos.
4.	Hermaphrodite caliper 150 mm	10 Nos.
5.	Divider spring 150 mm	10 Nos.
6.	Centre punch 100 mm	10 Nos.
7.	Hammer B.P. 0.5 kg	10 Nos.
8.	Combination plier 150mm	10 Nos.
9.	Safety glasses	10 Nos.
10.	File flat bastard 300mm	10 Nos.
11.	File flat 2nd cut 250 mm	10 Nos.
12.	Engineers screw driver	10 Nos.
13.	File flat smooth 200 mm	10 Nos.
14.	Cold chisel flat 25 x 200 mm	10 Nos.
	Tools, Instruments and General Shop Out fits	
15.	Granite Surface plate1000mm x 630 mm grade 1	4Nos.
16.	Metal stand Table for surface plate 900 x 900 x 1200mm	4Nos.
17.	Screw Driver Set (multiheads)	1Set
18.	Scribing block universal 300mm	2Nos.
19.	Vee Block universal 300mm	2Nos.
20.	Try square 150 mm	2Nos.
21.	Outside spring caliper 200 mm	2Nos.
22.	Divider spring 200mm	2Nos.
23.	Inside spring caliper 200mm	2Nos.
24.	Straight edge steel 1 metre	1No.
25.	Straight edge steel 500 mm	1No.
26.	Steel tape 2 metre in case	1No.
27.	Spirit level 2V 250, 05 metre	1 No.
28.	Hammer B.P. 800 gms with handle	6 Nos..
29.	Screw driver, heavy duty 300mm with handle	4 Nos.
30.	Hammer lead 1 Kg	2 Nos
31.	Combination set 300mm	2Nos
32.	Spindle blade screw driver 100mm	2 Nos.
33.	Allen hexagonal keys 2.5 to 12	2 sets
34.	Spanner D.E.C.P. series 2(7 pcs. each)	6 setsof
35.	Adjustable spanner 12 Nos	3 Nos.
36.	Reduction sleeve MT as required	1Set
37.	Angle plate size 200 x 100 x 200mm	2 Nos.
38.	Angle plate adjustable 250 x 150 x 175	2 Nos.
39.	Solid parallels in pairs (Different sizes) in Metric	12 pairs
40.	Oil can pressure feed 500 mg	6 Nos.
41.	Oil stone 150 x 50 x 25 mm	2 Nos.

42.	Twist drills 3mm to 13mm (Parallel Shank)	1 set
43.	Drill chuck 0 -20 with taper shank	1 No.
44.	Centre drill A1 to 5	2 sets
45.	Grinding wheel dresser (star type)	1No.
46.	Clamps C 100mm	2 Nos.
47.	Clamps C 200mm	2 Nos.
48.	Tap and die set in box metric pitch	1 set
49.	Drill HSS taper shank	1 set
50.	File flat 2nd cut 250 mm	4 Nos.
51.	File flat smooth 200mm	4 Nos.
52.	File H/R 2nd cut 250 mm	4 Nos
53.	File triangular smooth 200mm	4 Nos.
54.	Needle file set	1 No.
55.	File square 2nd cut 250mm	4 Nos.
56.	Micrometer depth gauge 0-150mm	8Nos.
57.	Direct reading Vernier caliper 0 to 300	4 Nos.
58.	Vernier height gauge 250 mm	1 No.
59.	Vernier bevel protractor with least count of 5 minutes	1 No.
60.	Radial drill 1200mm motorized with tapping attachment	1 No.
61.	Drilling machine pillar 20mm capacity with accessories	1 No.
62.	Pedestal grinder	1 No.
63.	Hand Drilling Machine Power (10 mm)	1 No.

Sr. No.	**Workshop furniture**	**Qty.**
1	Suitable Work Tables with vices	As required.
2	Stools	17Nos
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos
5	Trainees locker	2 Nos
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

Theory & Practical – II

Basic Sheet metal work, Fastening, Welding.

Theory	Practical
Safety in shop floor - Tools & equipments – Safety - Identification and uses of tools & accessories – Mallets, nylon hammers, bench vice, sheet formers, strips and shears etc.	Safety in shop floor - Tools & equipments – Safety - Identification and uses of tools & accessories –Mallets, nylon hammers, bench vice, sheet formers, strips and shears etc.
Sheet metal Classification and uses, cutting methods - straight cutting, circle cutting - Louver cutting, Nibbling, Slot cutting & Notching - Sheet metal works – Folding, Bending, Flanging, etc.. - Solder – Different types of solder and their uses (Soft & Hard solder) Heating appliances.	Practice in scribing of straight line, bisection of straight lines with marking tools - Planishing of sheet metal - Practice on hand soldering method (Lead & Tin)
Description of Folding & bending machines - Description & used of guillotine shears and circle cutting machines. - Description and use of hand punching machine Description of Drilling machine, Drill bit etc.,	Practice in cutting sheet metal to different shapes using various types of snips & Nibbling machines - Folding / bending sheet metal 90º using wooden mallet
Methods of Laying out pattern - Parallel line method - Radius line method Triangular line method - Laying out pattern of cylinder cut obliquely	Practice on removing Dents of spherical and hemi spherical articles. - Practice on cutting cylinder obliquely to make 90º L piece with equal diameter and join them at right angle.
Various types of Rivets, Riveting methods and application, Part of Rivets, Rivet materials, Joints types, Advantages and disadvantages of Riveting.	Riveting – Identification of Rivets – Selection of Rivets and Riveting practice for zig zag, chain Diamond Riveting
Fastening of sheet metal - Various types of fastening devices, Various types of fastening, Permanent / Semi permanent - Types of screws, washers, bolts and nuts, etc.	Identification of fasteners used on sheet metal works - Fabrication by threaded Fasteners – Simple joints.
Clips and connections - Their uses, Types and allowance of clips . Government clips, Drive clip, Mailing clip etc., - Introduction to tube & pipe - Pipe bending machine manual operation and application on pipe bending	Fastening of sheet metal - Various types of fastening devices, Various types of fastening, Permanent / Semi permanent - Types of screws, washers, bolts and nuts, etc.
Kinds of Aluminium Frames, Square, Rails, beads, angles etc., - Fastening system of making Doors, Windows, fixing locks etc.,	Exercise involving practical work on Aluminium sheet, using Pop Rivet, Aluminium Windows with extruded sections. - Make simple railing square frame doors. - Making a dust pan cover and handle riveted

Types of welding processes and application - Nomenclature of Fillet and groove welds - Welding terms and definitions - Oxy-Acetylene welding plant – description operating procedures, safety etc. - Types of metals and characteristics	Safety in Shop floor - Identification of tools and accessories used for Gas and Arc welding - Setting up of Gas Welding Plant - Opening and closing procedure of gas welding plant - Lighting and adjustment of Oxy-Acetylene flame - Beading practice on MS sheet with and without filler rod
Setting up Arc Welding plant - Striking an Arc and depositing straight and wearing beads on MS in Flat position	Setting up Arc Welding plant - Striking an Arc and depositing straight and wearing beads on MS in Flat position
Types of Oxy-Acetylene flames and their uses. - Chemistry of Oxy-Acetylene and flame temperatures - Oxy-Acetylene regulators – description and safe operating procedures - Oxy Acetylene welding blow pipes types description care and maintenance - Oxy Acetylene welding parameters – Blow pipe size, pressure setting and filler rod size for different sheet thickness	Close square butt joint – on M.S. Sheet by gas welding in flat position - Open square butt join on M.S. sheet by gas welding in flat position - Fillet T joint on M.S. Sheet by gas welding in flat position
Principles of Oxy Acetylene cutting process - Selection of blow pipe size, pressure setting for various thickness of MS plates - Types & function of flux of shielded Metal Arc Welding electrodes and coating factor - Coding of SMAW electrodes as per BIS/AWS - Selection criteria of electrode types and diameter - Principle of welding Arc, its characteristics and Arc length - Arc welding procedure and technique	Types of Oxy-Acetylene flames and their uses. - Chemistry of Oxy-Acetylene and flame temperatures - Oxy-Acetylene regulators – description and safe operating procedures - Oxy Acetylene welding blow pipes types description care and maintenance - Oxy Acetylene welding parameters – Blow pipe size, pressure setting and filler rod size for different sheet thickness
Welding positions and their significance - Filler rods and fluxes for brazing and soldering Gas Welding Techniques - Distortion and methods of control	Outside and Inside corner joint – on M.S sheet by gas welding in flat position - Brazing with Oxy-Acetylene flame - Silver soldering and Oxy-Acetylene flame
Basic Electricity applicable to welding - Arc welding power source, AC Transformers, DC welding rectifier, Dc welding generator and their features - Care and maintenance of welding power source - Polarity – types and application	Inside corner joint on MS by SMAW in flat positions - Outside corner joint on MS by SMAW in flat position - Single ‘V’ but joint on MS by SMAW in flat position

Arc blow and its control - Metals and their Weldability - Necessity of pre-heating and post heating while welding alloy steels	Pipe butt joint on MS pipe by Oxy-Acetylene welding in 1G position - Pipe to Sheet flange joint on MS by Oxy – Acetylene welding in horizontal – vertical position
Welding defects causes and remedy - Inspection and testing of welding	Pipe butt joint on MS pipe by SMAW in 1 G position - Pipe to plate flange joint on MS by SMAW in horizontal – vertical position

List of Tools, Machinery, Equipments

Sr.No.	Item	Qty.
	List Of Hand Tools	
1.	Steel Rule 300 mm	10
2.	Wing Divider 200 mm	10
3.	Centre Punch 100 mm	10
4.	Spring Dividers 150 mm	10
5.	Ordinary Wooden Mallet 50 mm	10
6.	Cross Peen Hammer 0.25 Kg with handle	10
7.	Protractor with blade 150 mm	10
8.	Steel Tape 2 meters	10
9.	Ballpane Hammer 0.5 Kg with handle	10
10.	Scriber 150mm x 3 mm (Engineers)	10
11.	**Shop Out Fit**	
12.	Steel Square 450mm x 600 mm	4 Nos.
13.	Sheet Metal Gauge	2Nos.
14.	Stake Round and Bottom	4 Nos.
15.	Half Moon Stake	4 Nos.
16.	Funnel Stake	4 Nos.
17.	Anvil Face Stake	4 Nos.
18.	Bick Iron stake	4 Nos.
19.	Tinmans Horse	2 Nos.
20.	Hammer Peaning with handle	4 Nos.
21.	Hammer Creasing with handle	4 Nos.
22.	Hammer Planishing with handle	4 Nos.
23.	Hammer Block with handle	2 Nos.
24.	Sher Tinmans 300 mm	8 Nos.
25.	Snips straight 250 mm	8 Nos.
26.	Right cut snips 250 mm	4 Nos.
27.	Left cut Snips 250 mm	4 Nos.
28.	Hand Shear Universal 250 mm	4 Nos.
29.	Punch Round 3 mm , 4mm & 6mm Dia	4 Nos
30.	Punch Round 4 mm Dia	4 Nos
31.	Punch Round 6 mm Dia	4 Nos
32.	Rivet sets snap and Dolly combined 3 mm ,4 mm, 6mm	4 each
33.	Chisel cold flat 25 mm x 250 mm	4 Nos
34.	Punch Letter 4mm and Punch Number 4 mm	1 set each

35.	File flat 250 mm second cut and smooth	2 each
36.	File flat 250 mm smooth	2 Nos.
37.	File flat 300 mm bastard	2 Nos.
38.	File half round 300mm smooth	2 Nos
39.	Hacksaw frame 300 mm adjustable (tubular)	4 Nos.
40.	Hand Groover 3 mm, 4mm, 5mm	4 Nos.
41.	Plier Combination 150 mm	2 Nos
42.	Grip Wrench 200mm	2 Nos
43.	Ladle 150 mm Dia	2 Nos
44.	Blow Lamp 1 litre	2 Nos
45.	H.S.S. Twist Drill 3 mm, 4mm & 6 mm (Parallel Shank)	3 each
46.	Hand Drill 0 to 6 mm, 8mm, 10mm & 12mm	2 each
47.	Soldering Copper Hatchet type 500 gms	8 Nos
48.	Pneumatic rivet gun	2 Nos.
49.	Trammel Point (with beam 600 mm)	1 No.
50.	Vernier caliper (0mm – 150mm)	1 No.
51.	Micrometer outside (0 to 25mm)	1 No.
52.	Raspcut file 250 mm	4 Nos.
53.	D.E.Spanner G.P (6 mm to 32 mm) (Set of 12 spanner)	2 set
54.	Bessing Mallet	4 Nos.
55.	Endfaked Mallet	4 Nos.
56.	Soft Hammer (Brass, Copper, Lead, Rubber and Rawhide heads with handle)	4 Nos.
57.	Steel Rule 600mm	4 Nos.
58.	Oil Can Pressure feed 500 ml	2 Nos.
59.	Raising Hammer with handle	4 Nos.
60.	Rawl Punch holder and bits (No.8,10, 12,14)	2 sets
61.	Hollowing Hammber with handle	4 Nos.
62.	Tripaning tool 70mm	1 No.
63.	Safety Glasses	4 pairs
64.	Handvice 50mm	10Nos.
65.	Portable Electric drill (Single phase)	2 Nos.
66.	Crow bar 910 x 25mm	2Nos.
67.	Trowel Medium	1 No.
68.	Trowel small	1No.
69.	Poprivet gun	2 Nos.
70.	Lazy Tong	2 Nos.
71.	Screw Driver 250mm	2 Nos.
72.	Round File 2nd Cut 250mm	4 Nos.
73.	Triangular File Smooth 250mm	4 Nos.
74.	Square File 2nd Cut 250mm	4 Nos.
	General Installation	
75.	Liquified Petroleum Gas (LPG) Cylinder, Regulator and	2 Nos.
76.	Bench lever shears 250mm Blade x 3 mm Capacity	1 No.
77.	Air Compressor (Pressure and displacement of air)	1 No.
78.	Spray Gun (Painting) 500 ml	1 No.

79.	Pillar type drilling machine 12mm	1 No.
80.	Circle Cutting Machine 300 mm Dia	1 No
81.	Guilltotine Shearing Machine foot operated (1 mt x 18G Capacity)	1 No.
82.	Slip roll former 1.6mm x 1000 mm	1 No.
83.	D.E. Grinder Pedestal motorized 200 mm	1 No.
84.	Anvil 50 Kgs with Stand	1 No.
85.	Bench vice 120mm, 150mm	2 each
86.	Fly press/Ball press No.4 single body	1 No.
87.	Buffing and Polishing Machine	1 No.
88.	Nibbling Machine	1 No.
89.	Spinning Lathe	1 No.
90.	Seaming Machine	1 No
91.	Black Board with Easel	1 No
92.	Wooden Rule 450 mm	1 No.
93.	Portable Nibbler	2 Nos.
94.	Portable Pneumatic Shear	2 Nos.
95.	Pipe Bending Machine (Hydraulic type) 12mm to 30mm	1 No.
96.	Hand Press Brake Capacity (0.8mm)	1 No.
97.	Ag4 & AG 7 hand grinders	1 each
98.	Spot Welding Machine	1 No.
99.	Tin smiths bench folder 600 x 1.6mm	1 No.
100.	Beading Machine with 380mm throat clearance (with crimping rollers)	1 No

Sr.No.	**Description of tools**	**QTY**
1	Gloves pair leather	10 Nos.
2	Apron leather	10 Nos.
3	Screen welding helmet type	10 Nos.
4	Screen welding hand	10 Nos.
5	Goggles pair welder	10 Nos.
6	Hammer scaling 0.25 kg. With handle	10 Nos.
7	Chisel cold flat 19 mm	10 Nos.
8	Centre punch 9mm x 127 mm	10 Nos.
9	Dividers 20 cm	10 Nos.
10	Caliper outside 15 cm	10 Nos.
11	Rule 60 cm two fold brass tipped to read inches and mm	10 Nos.
12	Wire brush (M.S)	10 Nos.
13	Spark lighter	10 Nos.
14	Chipping screen hand	10 Nos.
15	Safety boots for welders	10 Nos.
16	Safety goggles	10 Nos.
17	Safety goggles	10 Nos.
18	Scriber 15 cm	10 Nos.
19	Tongs holding 30 cm	10 Nos.
20	Wire brush (S.S)	10 Nos.
21	Brass Rule 30 cm or nickel chrome steel rule 30 cm	10 Nos.

Theory & Practical – III

Basic Machine shop Practice, Metals & Surface Finishing Technique.

Theory	Practical
Manufacturing processes in brief - Outline of various subject to be covered - Disciplinary rules of the Institute, Training and other facilities available. - Introduction to Lathe, description - Lathe types – construction – parts and functions Specification of a centre lathe, lathe operations.	Manufacturing process and their importance in Industries - Introduction to an Engine Lathe, identification of different parts of engine lathe, holding the job in 3 jaw chuck, - Perform facing and plain turning operation to an accuracy of ±0.1mm
Work holding devices – Mounting, dismounting procedure and their safety. - Lathe tools, their angles for roughing and finishing operation - Taper – types and uses - Calculation on taper - Different methods of producing a taper on a lathe, their merits & demerits Types of threads, forms of thread and depth calculation.	Hold round job on independent chuck & perform the following operations - Facing, Plain turning, Step turning, Taper turning - Turn an angular surface – By compound slide method. - Setting a grooving tool & performing an undercutting operation for threading - Perform Chamfering operation - Setting a threading tool and cutting a 'V' thread
Calculation of spindle speeds, feeds & depth of cut for different lathe operations. - Method of producing a thread on a lathe. - Cutting tool materials - Types of coolants and their applications	Performing center drilling, drilling and boring operation. - Cutting "V" thread on through bore. - Performing parting off operation - Performing knurling operation - Demo on parallel turning between centers.
Milling machine - description - construction - types - specifications and applications. Merits and demerits of different types of milling machine - Work holding devices and cutter holding devices. - Processes of milling – upmilling, down milling, face milling and end milling.	Horizontal milling machine - Identifying different parts, importance of each part - work holding devices and hand tools Mill a plain surface using plain milling cutter / slab milling cutter and Checking the flatness with tri-square. Milling six faces of a cuboidal block using plain milling cutter to an accuracy of ± 0.1mm. Checking the squareness with trisquare and the size with vernier.
Classification of different types of milling cutters and their uses. - Nomenclature of milling cutters. - Selection of cutting speed, feed and depth of cut for different milling - Operations.	Step milling using side and face milling cutter. - Angular milling using angular milling cutter and checking with bevel protractor. - Slot milling using slot milling cutter / slitting saw. - Vertical milling machine:- Familiarisation and mounting of face milling cutter on a vertical milling machine. - Face mill using face milling cutter

Step milling using end mill. - Slot milling using a slot drill - Milling angular surface by tilting the spindle head & universal vice - Milling a hexagon / square on a round rod using direct indexing. - Milling a tung and groove and matching.	Step milling using end mill. - Slot milling using a slot drill - Milling angular surface by tilting the spindle head & universal vice - Milling a hexagon / square on a round rod using direct indexing. - Milling a tung and groove and matching.
Grinding - Principle, types of grinding machine and their uses. - Safety in grinding operation	Safety precautions to be followed in grinding - Re-sharpening of plain turning tool on pedestal grinder to an accuracy of one degree. - Check the tool angle using bevel protractor. - Familiarize with controls of surface grinding machine
Grinding wheels - Types of abrasives, grain size, grade, structure, bond types, standard marking system & selection criteria. - Types of portable grinder – pneumatic & electrical.	Preparation of edges for welding / Fitup using portable grinder
Importance of the trade - Metals – ferrous, non-ferrous, physical and Mechanical Properties – Weldable and non-weldable metal - Indian Standard specification for metals	Induction training – familiarization with the Institute - Introduction to Industrial safety equipments & use - Identification of tools & equipments used in the section
Cast iron – its properties and applications - Steel and their classification, composition, properties & uses - Aluminium and its properties	Identification of metals - Sound Test for metal Identification - Simple spark Test with pedestal grinder for metal Identification
Principle and operation of hardness testing machine, brinell hardness & Vickers hardness testing machine - Physical and Mechanical properties of metal – Hardness, Tenacity, toughness, Brittleness, Ductility, malleability etc - Strength of metals – Tesile strength, Impact strength, Shear strength, compressive strength ctc. - Identification of steels by spark test - Colour code of metal - ISI specification of metals	Measuring hardness of metals with Rockwell hardness and Brinell hardness testing machine - Measuring Tensile strength of metals using UTM - Measuring Impact strength of metals with Impact Testing machine

Safety precaution to be observed in heat treatment shop. - Need of heat treatment - Different HT processes – Annealing Simple H T using Muffle furnace (Hardening & Tempering). - Practice of stress relieving on welded components.	Operation of furnace and their controls - Study of Temperature measuring Instruments ,Normalizing, Hardening, Tempering, Stress relieving , case hardening etc. - Types of furnaces - Necessity of pre heating and post heating - Quenching methods – Iron Carbon phone diagram for plain carbon steel – critical temp. The structure of alpha, gamma and delta iron. - Allotrophic transformation of iron - eutectoid – hypoeutectoid & hypereutectoid iron.
Surface defect on Casting, Forging & Weldments – - Surface Inspection Testing - Visual Inspection of defects - Non Destructive testing methods - Dye Penetrant Testing - Magnetic Particle Testing	,Normalizing, Hardening, Tempering, Stress relieving , case hardening etc. - Types of furnaces - Necessity of pre heating and post heating - Quenching methods – Iron Carbon phone diagram for plain carbon steel – critical temp. The structure of alpha, gamma and delta iron. - Allotrophic transformation of iron - eutectoid – hypoeutectoid & hypereutectoid iron.
Need for surface finishing - Safety precaution - Safety of the painter, safety of paint in storage - Painter hand tools and equipments - Painting Procedure - Surface cleaning of metals for removing oil / grease, rust, dust, moisture, old paint, mud / clay , spatters etc.	Use of tools for surface finishing - Scrapping practice using Scrapping knives, chisel knife, moulding knife, pallet knife, wire brush, emery sheet etc
Surface preparation methods - use of emulsifiers, Solvent cleaning , Water washing, Abrasive cleaning, Chemical cleanings, Sand blasting, Short blasting etc., - Polishing -Polishing with compound and cloth wheels, Polishing with abrasive covered wheels, polishing with coated wheels - Buffing – buffing materials – Pumice, Tripoli, rouge, whiting and satin finish	Painting Practice - application of putty , using putty knife etc- before painting - Practice on application on primer. - Painting practice – Brush painting – Dip painting – Roller painting – spray painting - Polishing & buffing
Types of primer and its application.	Phospating practice on metals

List of Tools

Sr.No.	Item	Qty.
1.	Steel rule 30 cm graduated both in English & Metric units	10 Nos.
2.	Outside spring caliper 150 mm	10 Nos.
3.	Inside spring caliper 150 mm	10 Nos.
4.	Hermaphrodite caliper 150 mm	10 Nos.
5.	Divider spring 150 mm	10 Nos.
6.	Centre punch 100 mm	10 Nos.
7.	Hammer B P 0.5 Kg	10 Nos.
8.	Combination plier 150 mm	10 Nos.
9.	Safety goggle	10 Nos.
10.	File flat bastard 300mm	10 Nos.
11.	File flat 2nd cut 250 mm	10 Nos.
12.	Engineers screw driver	10 Nos.
13.	File Flat smooth 200 mm	10 Nos.
14.	Surface plate 900 x 900 x 1200 mm with Table	1 No.
15.	Marking off table 1200 x 1200 x 900mm high	1 No.
16.	Scribing block universal 300 mm	2 Nos.
17.	" V " block 100/7-80-A	2 Nos.
18.	Try Square 150 mm	2 Nos.
19.	Outside spring caliper 200 mm	2 Nos.
20.	Divider spring 200 mm	2 Nos.
21.	Steel rule 60 cm graduated both in English and Metric units	2 Nos.
22.	Spirit level 2V 250, 05 metre	1 No.
23.	Hammer B P 800 gms with handle	12 Nos.
24.	Screw Driver, heavy duty 300 mm with handle	4 Nos.
25.	Combination set 300 mm	1 No.
26.	Reduction sleeve MT (to suit the machine)	1 set
27.	Spanner D.E.G.P series 2	6 sets
28.	Solid parallels in pairs (Different sizes) in Metric	4 pairs
29.	Oil can pressure feed 500 mg	6 Nos.
30.	Oil stone 150 x 50 x 25 mm	2 Nos.
31.	Twist Drill Taper shank set 12 to 20 mm in step of 1 mm	2 sets
32.	Twist drills& Drill chucks including keyless drill chuck	1 set
33.	Assorted carbide lathe tools with holder different shapes and sizes	As Reqd.
34.	Hacksaw frame adjustable 250 - 300mm with blades	2 Nos.
35.	Plier cutting 200 mm	2 Nos.
36.	Hand hammer 1 Kg with handle	2 Nos.
37.	Centre drill 2,3,& 4	4 Sets
38.	Cylindrical cutter dia 63 x 90 x bore dia 27mm	2 Nos.
39.	Cylindrical cutter dia 80 x 90 x bore dia 27mm	2 Nos.
40.	Side and face cutter A 80 x 8 x bore dia 22mm	2 Nos.
41.	Side and face cutter A 160 x 10 x bore dia 27mm	3 Nos.
42.	Side and face cutter A 100 x 12 x bore dia 32mm	2 Nos.
43.	Side and face cutter B 160 x 16 x bore dia 32mm	2 Nos.

44.	Side and face cutter A 200 x 20 x bore dia 32mm	3 Nos.
45.	Side and face cutter A 100 x 10 x bore dia 32mm	2 Nos.
46.	Equal angle cutter 45^0 / 100 x bore dia 16 mm	2 Nos.
47.	Face mill dia 30 with 2sets of carbide inserts	2 Nos.
48.	Face mill dia 40 with 2sets of carbide inserts	2 Nos.
49.	Face mill dia 80 with 2sets of carbide inserts	2 Nos.
50.	Shell end mill dia 50 – 27 bore	2 Nos.
51.	Shell end mill dia 80 – 32 bore	2 Nos.
52.	Parallel of shank end mill dia 6, 8, 10 & 12	4 each

Workshop Furniture

Sr. No.	**Item**	Qty.
1	Suitable Work Tables with vices	As required.
2	Stools	10 Nos.
3	Discussion Table	1 No
4	Tool Cabinet	2 Nos.
5	Trainees locker	2 Nos.
6	Fire fighting equipment, first aid box etc	As required
7	Book shelf (glass panel)	1 No.
8	Storage Rack	As required
9	Storage shelf	As required

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