

MAHARASHTRA STATE BOARD OF VOCATIONAL EDUCATION EXAMINATION, MUMBAI - 51

1	Name of Course	Diploma Course in Welding Technology									
2	Course Code	403418									
3	Max no. of Students	25									
4	Duration	2 Year									
5	Course Type	Full Time									
6	No. of Days per week	6 days									
7	No. of hours per day	7 Hrs									
8	Space require	Theory Class Room – 200 sqft Three Practical Lab – 500 sqft each									
9	Entry qualification	SSC Pass									
10	Objective of syllabus	To get knowledge of different metal joining processes and their applications. To understand metal cutting methods, special welding processes, equipments and accessories and their applications, To get knowledge of different welding machines and their control. To Understanding m/c Drawing, To Prepare Drawing using CAD, Awareness of Safety.									
11	Employment opportunities	The student can get jobs in fabrication industries or with working experience will be in a position to start his own independent Business.									
12	Teachers Qualification	1) For Vocational subject - B.E.Mech. 2) For Non Vocational Subject - Master Degree in Concern subject									
13	Teaching Scheme –										
	Sr.	Subject	Subject Code	Clock Hours / Week				Total			
				Theory	Practical						
	1	English (Communication Skill)	90000001	2 Hrs	1 Hrs			3 Hrs			
	2	Elective – I		2 Hrs	1 Hrs			3 Hrs			
	3	Elective – II		2 Hrs	1 Hrs			3 Hrs			
	4	Mechanical Technology and Material Science	30340001	3 Hrs	8 Hrs			11 Hrs			
	5	Basic Welding Theory and Practice	30340007	3 Hrs	8 Hrs			11 Hrs			
	6	Advance Welding Technology & Machines	30340027	3 Hrs	8 Hrs			11 Hrs			
	Total							42 Hrs			
14	Internship	Two Months Summer Internship from 1 st May to 30 th June is Compulsory.									
15	Examination Scheme – Final Examination will be based on syllabus of both years.										
	Paper	Subject	Subject Code	Theory			Practical		Total		
				Duration	Max	Min	Duration	Max	Min	Max	Min
	1	English (Communication Skill)	90000001	3 Hrs	70	25	3 Hrs	30	15	100	40
	2	Elective – I		3 Hrs	70	25	3 Hrs	30	15	100	40
	3	Elective – II		3 Hrs	70	25	3 Hrs	30	15	100	40
	4	Mechanical Technology and Material Science	30340001	3 Hrs	100	35	3 Hrs	100	50	200	85
	5	Basic Welding Theory and Practice	30340007	3 Hrs	100	35	3 Hrs	100	50	200	85
	6	Advance Welding Technology & Machines	30340027	3 Hrs	100	35	3 Hrs	100	50	200	85
										900	375
16	Teachers – Three Teachers per batch for vocational component. For English, Elective-I & II guest faculty on clock hour basis.										
17	a) For Elective I – Student can choose any one subject Code Subject Name 90000011 Applied Mathematics 90000012 Business Economics 90000013 Physical Biology (Botany & Zoology) 90000014 Entrepreneurship 90000015 Psychology						b) For Elective II – Student can choose any one subject Code Subject Name 90000021 Applied Sciences (Physics & Chemistry) 90000022 Computer Application 90000023 Business Mathematics				

Subject Name - **Mechanical Technology and Material Science**

Subject Code - 30340001

Theory – 1 st year	Practical – 1 st year
1] Fundamental of material <ul style="list-style-type: none"><input type="checkbox"/> Introduction of metals and non metals<input type="checkbox"/> Structure of metal<input type="checkbox"/> Formation of grain<input type="checkbox"/> Imperfection in crystals<input type="checkbox"/> Deformation in metal and change in properties<input type="checkbox"/> Fracture<input type="checkbox"/> Equilibrium diagram<input type="checkbox"/> Iron, carbon equilibrium diagram<input type="checkbox"/> Time temperature transformation diagrams	1. Take the tensile test of M.S. specimen & Draw stress strain diagram, yield pts.
2 Ferrous metals and alloys <ul style="list-style-type: none"><input type="checkbox"/> Pig iron and cast iron<input type="checkbox"/> Effect of chemical elements on iron<input type="checkbox"/> Classification of steel and its application<input type="checkbox"/> Alloy steel and special alloy steel 3 Non Ferrous metals and alloys <p>Introduction to non ferrous alloys</p> <ul style="list-style-type: none"><input type="checkbox"/> Aluminum and its alloys<input type="checkbox"/> Copper and its alloys<input type="checkbox"/> Lead and its alloys<input type="checkbox"/> Nickel and its alloys<input type="checkbox"/> Alloys for high temperature service<input type="checkbox"/> Metal for nuclear energy	2. Study the mechanical properties like Elasticity, ductility, malleability, Brittleness, toughness of Different materials – M.S., C.S. Bronze, Copper, Aluminum Study the Hardness test <ul style="list-style-type: none"><input type="checkbox"/> Brinell Hardness test<input type="checkbox"/> Rockwell hardness test

4 Crystal Structures

- ☐ Fundamental concept
- ☐ Unit Cells
- ☐ Metallic crystal structures
- ☐ FCC Structure
- ☐ BCC Structure
- ☐ HCP Structure
- ☐ Weld ability

5 Properties of Metal

☐ **Mechanical properties of Metal**

Elasticity, ductility, malleability, brittleness, Toughness, Stress strain behavior, Elastic limit, hooks Law, UTS, poissons ratio, factor of safety, hardness and hardness tests shear strength, resistance.

☐ **Electrical properties of Metal**

Electrical conductivity, resistivity, electrical Characteristic of commercial alloys

Theory – 1 st year	Practical – 1 st year
<p><input type="checkbox"/> Thermal properties of metal</p> <p>Heat capacity, thermal expansion, thermal Conductivity, thermal stress</p> <p>6 <input type="checkbox"/> Magnetic Properties of metal</p> <p>Basic concepts, diamagnetism and Para magnetism, ferromagnetism, influence of temperature on magnetic behavior, domain and hysteresis, soft and hard magnetic material.</p> <p>7 Heat Treatment of material</p> <p><input type="checkbox"/> Normalizing</p> <p><input type="checkbox"/> Hardening</p> <p><input type="checkbox"/> Quenching and tempering</p> <p><input type="checkbox"/> Annealing</p> <p><input type="checkbox"/> Stress Relieving</p> <p><input type="checkbox"/> Case carburizing and case hardening.</p> <p><input type="checkbox"/> Toughening</p> <p>Weld ability of Metal definition and concept Effect of alloying elements on weld ability Purpose and types of weld ability tests</p>	<p>3. Study the Electrical Properties of some conductors (conductivity, Resistivity) Aluminum, Copper, Brass, Tungsten</p>
<p>8 Cracking phenomena in steel</p> <p><input type="checkbox"/> Cold crack due to hydrogen</p> <p><input type="checkbox"/> Hydrogen cracking</p> <p><input type="checkbox"/> Measurement and control of hydrogen in the deposited weld metal</p> <p><input type="checkbox"/> Cracking mechanism in the weld metal and HAZ</p> <p><input type="checkbox"/> Weld decay</p> <p><input type="checkbox"/> Lamellar tearing</p> <p><input type="checkbox"/> Hot cracking</p> <p><input type="checkbox"/> Reheat cracking</p>	<p>4. Study the effect on materials with heat treatment Normalizing, Hardening, Quenching & Tempering Annealing, Stress Relieving, Case Hardening, Toughening For Different Material's M.S., C.S., Nickel, Copper</p>

Theory – 2 nd year	Practical – 2 nd year
<p>1 Bench work and fitting</p> <p>Introduction- Vices – Hammers- Chisels-</p> <p>Chipping- Files- Filing- Scraper-Scraping- Grinding and Polishing- Hacksaw sawing- Marking tools – Surface plate- Scriber – Punch- V block- Angle plate- Try square – Marking out –</p> <p>Drill- Drilling- Reamer- Reaming- Taps- Tap drill size-Tapping – Dies and stock- Dieing.</p> <p>2 Sheet Metal Work</p> <p>Introduction – Metal used in sheet metal work-</p> <p>Sheet metal hand tools- Sheet metal operation-Sheet metal joint- Hems and Sems – Sheet metal allowance- Sheet Metal working</p> <p>machine-Laying out a pattern</p> <p>3 Plumbing, Threading, Fasteners & joints</p> <p>Plumbing- Specifications of pipes- Material used</p> <p>for pipes-Pipe fitting & Joints-Taps & valves – Plumber tools – Threaded fasteners- screw threads and their uses- Indian standard</p> <p>threads-Cap screw and machine screw-Set screw- Methods of producing screw threads- Bolts- Studs- Forms of nuts- Riveting joints.</p> <p>4 Smithy and Forging</p> <p>Maintenance and application of smith health- Anvil- Swage block-Tongs-Hammer-Flatters- Measuring tools e.g.-Try square- Steel rules- Calipers-Operations e.g. up setting- drawing down- bending setting- forge welding.</p>	<p>Fitting</p> <p>1. Filing Flat surfaces:</p> <p>Checking flatness and square ness using a try square –</p> <p>Types of filing – Cleaning files.</p> <p>2. Chipping: Hints on chipping</p> <p>3. Hack sawing: Selection of blades for different metal sections - Fix hack</p> <p>sawing the material for the job blades maintaining. Correct tension and</p> <p>direction – Hack sawing. Filing ‘V groove and complex profile by file &</p> <p>check with profile gauge.</p> <p>4. Filing radius –check with radius gauge</p> <p>5. Check profile with profile gauges.</p> <p>6. Drill plate, Drilling, counter sinking, counter boring. Operations on job</p> <p>7. Drilling and Tapping: Internal threading of holes by using hand taps –</p> <p>determine the tap drill size, drilling, counter-sinking and tapping –</p> <p>precautions with tapping a blind hole.</p> <p>8. External thread cutting using die.</p>

5 Welding Technology

Welding Welding introduction to different welding processes, like gas Welding, ARC welding TIG, MIG, submerged arc welding, spot Welding, electrodes etc. Brazing methods & application, Knowledge of welding skills.

6 Metal Turning (Lathe)

6.1 Function of lathe, Types of lathe, the size of lathe, Descriptions & function of lathe parts,

6.2 Lathe accessories and attachments.

6.3 Operation on Lathe

6.4 Cutting Tools, Classification , Influence of tool angles.

6.5 Types of tools, cutting speed, Feed, Depth of cut,

6.6 Machining time. Cutting tool signature.

Theory – 2 nd year	Practical – 2 nd year
<p>7 DRILLING</p> <p>Introduction Types of drilling machine, Portable drilling machine, Sensitive drilling machine. Upright drilling machine, Radial Drilling Machine; Gang drilling machine, Multiple spindle drilling machine Automatic drilling machine, Deep hole drilling machine; The size of a drilling machine, Upright drilling machine parts. Radial drilling machine parts, Work holding devices, Tool holding devices, Drilling machine operation, Drilling machine tools.</p> <p>Twist drill nomenclature. Drill size Designation of drill material Reamer, reamer nomenclatures. Counter bore, Countersinks and spot face, Taps. Tap nomenclatures. Cutting speed Feed, Depth of cut, Machining time in drilling</p>	<p>Basic Workshop Practice</p> <p>1. Step turning and Radius forming: Free hand form turning – by using form tool.</p> <p>2. Drilling and Boring-Use of inside caliper and outside Micrometer for bore measurement.</p> <p>3. Drilling and reaming: by hand-Method of checking the bore With a plug gauge.</p> <p>4. Drilling and step Boring: Boring blind hole with a boring tool.</p>
<p>8 SHAPER</p> <p>Introduction. Types of shapers. Principal parts. Shaper size; Shaper mechanism; Work holding devices. Shaper operations. Shaper tools; Cutting speed, feed and depth of cut; Machining time.</p> <p>9 SLOTTING</p> <p>Introduction. Types of slotting machine; Slotter size; Slotting machine parts; Work holding devices; Slotter operation; Slotter tools; Cutting speed, feed and depth of cut.</p>	<p>5. Drilling, Boring and Recessing: Internal recessing to a size broader than the width tool – Form a recess.</p> <p>6. Shaping blind & open keyways on shaping machine</p> <p>7. Shaping irregular surfaces.(Concave / Convex)</p>
<p>Powder Metallurgy</p> <p>Introduction- Process Description- Manufacture of metal powder- Blending of powders- competing profiteering- Sintering- Secondary operation –ISO Static pressing – Product of</p> <p>powder metallurgy-Advantages of process – Disadvantages and limitation-Design considerations Introduction to CNC</p>	<p>8. Slotting internal grooves on slotting machine</p> <p>9. Welding Practical-fusion run with/without filler rod on MS Sheet – squire butt joint on MS sheet LAP,T& Edge joint on M.S. Sheet</p>

List of Books

- 1 M. N. Uppal A Text - book of engineering Chemistry
- 2 V. P. Mehta A Text - book of polytechnic Chemistry
- 3 Banswal, Mahajan and Mehta A Text - book of, Applied Chemistry
- 4 Hazra Choudhary Elements, of workshop technology
- 5 S.K.Hajra Choudhary Elements of workshop technology Vol-I First 1964 Media promoters & Publisher pvt. Ltd.
- 6 Mahajan Mechanical Technology Third 1989 Vrinda publication

Sr. No. Name of the equipment/ machinery NOS.

1	TRAINEES TOOL KIT	5
2	Try Square 10 cm Blade	5
3	Calipers outside 15 cm spring	5
4	Caliper inside 15 cm spring	5
5	Dividers 15 cm Spring	5
6	Calipers 15 cm Hermaphrodite	5
7	Scriber 15 cm	5
8	Punch center 10 cm	5
9	Screw driver 15 cm	5
10	Chisel cold 20 cm	5
11	Trammel 30 cm	5
12	Hammer ball peen 0.5 kg with handle	5
13	Hammer Mallet	5
14	Hammer Plastic	5
15	Hammer ball peen 0.5 kg with handle	5
16	File flat 25 cm second cut	5
17	File flat 25 cm second cut	5
18	Hacksaw frame adjustable 20-30 cm	5
19	Dot slot punch	5
20	Steel rule 15 cm English and metric	5

21	Steel rule 30 cm English and metric	5
22	Try square 20 cm Blade	5
23	Steel tool box	5
24	Scriber	5
25	Lock and keys	5
26	Combination plier	5
27	Jenny calipers	5
28	Aluminum tray 15 cm X 10 cm	5
29	Fellow polish cloth standard size	5

	SHOP OUTFIT & MEASURING INSTRUMENTS	
30	Straight edge 45 cm X 45 cm	1
31	Marking table 90X90 cm	1
32	Surface plate 45 cm X 45 cm	1
33	Vee Block pair 7 cm and 15 cm with clamps	1
34	Angle plate 10 X 20cm	1
35	Number Punch 3 mm set	2
36	letter Punch 3 mm set	2
37	Round punch 3 mm X 4 mm set of 2	2
38	File flat 20 cm bastard	2
39	Oil Stone 15 X 5 cm X 2.5 cm	
40	Spanner adjustable 10 cm	1
41	Chisel cold 20 cm cross cut	2
42	Chisel 10 cm flat	2
43	Drill twist 1.5 mm to 15mm (various sizes) by 0.5	2
44	Files assorted sizes and type including safe edge	10
45	Micrometer inside 50-150 mm with screen	2
46	Bench Vice 12 cm jaw	5
47	Work Bench 240 X 120 60 mm with screen	3

48	Drill point angle gauge	1
49	Vernier Calipers 20 cm	2
50	Vernier height gauge 30 cm	1
51	Huntington and diamond dresser	1
52	Taps and dies complete set (metric)	2 set
53	Hacksaw frame	5
54	Fire buckets with stand	1
55	Thread pitch gauge metric, BSX, BSF, MC, MF & SAE	1 each
56	D.E. spanner ser of 12 metric 6 mm to 32 mm	1 set
57	Ring spanner set at 12 metric 6 mm to 32	1 set
58	Stud extractor set of 3	1 set
59	Universal puller for removing pulleys, bearings	1 set
60	Unserviceable engine/gear box rear axle	1
61	Stud remover with socket handle	1
62	Combination pliers 15 cm	5
63	Depth guage (inch and metric)	1
64	Screw pinch gauge (inch and metric)	1 set
65	Feeler gauge 20 blades (inch and metric)	1
66	Aluminum tray 45 X 30 mm	5
67	Oil can 0.5 liter capacity	1
68	Surface gauge	1
69	Cylinder bore gauge (mercer)	1
70	Telescopic gauge	1
71	Steel measuring tape 10 meter in a case	2
72	Sets of Morse socket MT 0-1,1-2,and 2-3	1 set
73	Blow lamp	1
74	Torque wrenches 5-35 Nm,12-68 Nm&50-225 Nm.	1 each
75	Outside micrometer English 0-1,1-2,2-3,3-4,4-5,And 5-6 inches	1 each

76	Micrometer outside 1 to 25 mm,25mmto 50mm ,50 to75 mm,75 to100mm,100 to 125mm,125 to 150mm.	1
77	Surface gauge with dial test indicator plunger type i.e. 0.01 mm	1
78	Printed wall chart framed for display showing measuring instruments.	10
79	Inside micrometer English 2" to 6" with extension road	1
80	Vernier bevel protractor (metric and inch)	1
81	Vernier calipers (inch and metric) 6"x12"	1
82	Vernier micrometers(inch and metric)	1
83	Vernier height gauge 150 mm height (inch and metric)	1
84	Dial micrometer (inch and metric)	1
85	Small bore gauge (standard)	1
86	Dial test indicator to read (inch an metric)0.02mm	1
	GENERAL INSTALLATOIN /MACHINERIES	
87	Radial Drilling Machine 25mm capacity	1
88	Power Hacksaw	1
89	Rotary Cut off Machine	1
90	Shaping machine	1
91	Hydraulic Press 2 ton capacity	1
92	Surface plate (small)	1
93	Surface plate (big)	1
94	Standard Arc Welding machine	1
95	Horizontal milling machine	1
96	Bench Drilling machine 6-12mm cap Motorized with chuck and key	1
97	Grinding machine (general purpose)D.E. pedestal with 300mm dia wheels rough and smooth	1
98	Hydraulic Trainer with Power pack	1
99	Pneumatic Trainer	1
	Workshop furniture	
100	Suitable Work Tables with vices As required	1
101	Stools 25 Nos	25

102	Tool Cabinet 2 nos	2
103	Trainees locker 2 nos	2
104	Fire fighting equipment , first aid box etc As required	1
105	Book shelf (glass panel) 1 nos	1
106	Storage Rack As required	2
107	Storage shelf As required	2

Subject Name - Basic Welding – Theory and Practice**Subject Code - 30340007**

Theory – 1st year	Practical – 1st year
Welding - joining process Introduction- Definition- History of welding- Classification of welding- Heat sources as a basis for classification- Electricity- Gas flame- Forge or furnace heating- Electron beam- Chemical Reaction- Ultrasonic Vibration- Laser beam-. A) Electricity as a source of heat :- Arc welding- Resistance Welding- Induction Welding-. Depending on type of electrode- Carbon electrode arc welding- Metal Electro Arc Welding- Unshielded process:- Carbon arc welding- Twin carbon arc welding- Bare metal arc welding- Arc seam welding- Arc spot welding- Stud Welding. Shielded Process:- Shielded carbon arc welding- Inert gas carbon arc welding (CIG welding)- Shielded metal arc welding- Inert gas Tungsten Arc Welding (TIG)- Inert gas metal arc welding(MIG)- Submerged arc welding- Gas shielded stud welding- Impregnated tape metal arc welding- Atomic Hydrogen welding. B) Gas Flame as a source of heat:- Gas welding C) Forge or furnace heating:- Hammer welding- Die welding- Roll Welding. D) Electron Beam as Source of Heat:- Electron beam welding. E) Chemical Reaction as a source of heat:- Thermit welding.	1 Gas cutting of chamfer maintaining root face. 2 Nomenclature of single Vee butt joint. 3 Identification of different types of electrodes 4 Identification of different types of gas welding flames 5 Different sources of heat 6 Identification of different types of gas cylinders by their colour coding 7 Study of gas welding blow pipe. 8 Study of gas cutting blow pipe 9 Study of flash back arrestor 10 Study of temperature measuring instruments. 11 Study of iron- carbon diagram 12 Study of manufacturing of flux coated electrodes 13 Study of gas regulators & flow meters 14 Graphical presentation of weld defects 15 Study of weld decay in stainless steel welding

F) Sound as a source of heat:- Ultrasonic welding.

G) Light as a source of heat:- Laser Beam Welding.

Other Joining Process:-Flow welding- Friction Welding- Cold

Welding- Welding Plastics

Fundamentals of Welding:-

Selecting the appropriate welding process- Metallurgy- Mechanical

and physical properties of Metal- Weldability- Metal identification-

Types of joints- Butt joint- Cosues joint- Edge joint- Lap joint- T

Joint- Selecting the joint design- Joint preparation- Types of welds.

Groove Joint:- Square joint- Single V groove- Single Bevel Groove-

Single V groove- Single J groove- Double V groove- Double Bevel

groove- Double U groove- Double J groove weld.

Fillet Weld:- Concave fillet weld- convex fillet weld- Staggered

intermittent fillet welds- Chain Intermittent fillet weld.

Basic Weld Terminology:-

Root of the weld- Root Face- Groove face- Root Edge- Root opening-Bevel angle- groove angle- size of weld- Face of weld- Throat of fillet weld- Actual throat- Theoretical throat- Leg of fillet weld- The toe of the weld- The base metal- The electrode or filler metal- Welding positives- The flat position- The horizontal position- The vertical position- The overhead position- Welding sequence and related technology- Deposited metal- Flash(Expelled metal) – Deposition efficiency- Deposition Rate- Deposition sequence- The depth of fusion- Fusion zone- Head of weld bead- Welding problems- Weld spatters- Undercutting- Porous weld- Slag inclusion- Incomplete peretrath- Cracking.

<p>4.</p> <p>Safety and Health Measures:-</p> <p>Safety recommendations in welding & cutting:-</p> <p>Safety recommendations for installations & operation of gas welding & Cutting equipments –</p> <p>(a) Gas cylinder</p> <p>(b) Manifolding of gas cylinder.</p> <p>(c) Torches & Tips</p> <p>(d) Pressure regulators.</p> <p>(e) Hose for gas tubing</p> <p>(f) Other general precautions.</p> <p>Safety recommendations for installation & operation of arc welding & Cutting equipments.</p> <p>(a) Arc welding Machines</p> <p>(b) Electrode holders</p> <p>(c) Welding cables Explosion, fire & other hazards</p> <p>Protection of welders:- from welding rays – from sparks & spatters – Ventilation & health protections.</p> <p>Physics of Welding</p> <p>Introduction – Welding arc- Its Definition- Initiation – Structure and mechanism –Type of welding arc- Temperature measurement of welding –Arc characteristics (V-I-V-L) and anode spot characteristics –Arc stability –Arc blow –Introduction –Factors affecting arc blow – Types of arc blow – Mechanism of arc blow –Effects of arc blow and remedies of arc blow –Metal transfer – Introduction types of metal transfer-Forces affecting metal transfer – Effect of I and V on drop transfer –weld head geometry –Features of weld.</p> <p>Metallurgy of welding –</p> <p>Introduction –Welding arc –Heat flow and temp. distribution in and around weld metal –Cooling rate of welds –Metallurgical effects of welding –Weld metal solidification –Weld solidification rates-</p>	<p>1 All position fillet & buttwelding. M.S. 50x12x200 Arc welding --</p> <p>2 Single vee butt weld in overhead position. M.S. 50x12x200 Arc welding</p> <p>3 Double vee butt weld in overhead position. M.S. 50x12x200 Arc welding</p> <p>4 Pipe elbow joint. M.S. Pipe 75x5 Arc welding --</p> <p>5 Pipe butt weld in 5G (fixed) position. M.S. Pipe 75x5 Arc welding --</p> <p>6 All position fillet & butt weld. M.S. 100x15x300 Arc welding --</p> <p>7 Square butt joint on M S plate by right word welding technique in flat position. M.S. 100x15x300 Arc welding --</p> <p>8 Pipe elbow joint on m.s. pipe M.S.Pipe 50x3 Gas welding --</p>
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<p>Absorption of gases by welds-Their effects and prevention of gaseous contamination-gas metal reaction-Porosity in welds –Iron carbon TTT and CCT-Their utility and products of transformation – thermal effects of welding on metal and its mechanical properties –weld metal and heat affected zones –Hot and cold cracking – Corrosion of weld- Weld decay Dilution</p> <p>Gas Welding Equipments</p> <p>Gases-Gas welding rods-Gas welding flux-Welding tip cleaners – Torch lighters and spark lighters – Oxygen Cylinders –Hose and Hose connections- Welding torches-Mixer welding tip-Manifolds-Gas pressure Regulator-Single stage versus two stage Regulators-Welding clamps-Cylinders hand trucks- Welding outfits-</p>	<p>9</p> <p>Square butt joint & aluminum sheet</p> <p>Alu. Strips 50x3 Gas welding Non ferrous</p>
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<p>Gas Welding process-</p> <p>Definition-Oxyacetylene welding-Principle of operation – Types of welding flame-Chemistry of oxyacetylene flame –Lighting the torch – flame adjustment-Gas welding techniques- Leftward-Right /ward- Welding feeler metal rods and flux-Practical welding –Making a tack weld-Making weld beds – Torch manipulation –and movements- Making a weld without filler rod – Practicing with a welding rod – welding sheet steel with the welding rod – welding steel plate with the welding rod-undercutting – Overlapping – and normal weld held contour – Vertical welding position- Overhead welding position – Making common weld- Making welds in “T” joins –Making weld in lap joint – Multi layer welding- Advantages of gas welding- Disadvantages of gas welding- Application of gas welding – Oxy hydrogen and other fuel gas welding – Hydrogen –Propane – Butane – Metal gas used for gas welding purposes – Air acetylene welding- Definition – Principle of operation – Application</p> <p>Welding Electrodes.</p> <p>Types of Welding electrodes – Electrodes details- Non consumable or refractory electrodes- consumable electrodes- light medium and heavily coated electrodes – Categories of covered electrodes – Electrodes coating ingredients and their functions – Manufacture of electrodes – Selection of electrodes care and storage of electrodes-</p> <p>Classification and coating of mild steel and low alloy steel electrodes – American system- British System and Indian system- typical application of covered electrodes.</p> <p>Arc Welding Process</p> <p>Introduction- Selecting a power source – the Electric arc- Heat distribution of the arc- Arc creator – Arc blow – Arc length- Effect of arc length-Arc force and travel speed-Electrode polarity –determining the required current- Determining the circuit polarity – Selecting the proper Electrodes sizes and welding speeds – Welding position – Welding joints – Types of welds- Weld preparation – Welding problems- Remedies – Advantages- isadvantages- Applications</p>	<p>10</p> <p>Square butt joint & Copper to brass</p> <p>cop & brs strips 50x3 Gas welding Brazing</p> <p>11</p> <p>Reinforcement on round surface</p> <p>M.S. round bar 50x200 Arc welding Metal feeling</p> <p>12</p> <p>Repairing / welding & aluminum casting by aluminum electrode</p> <p>Any repairing parts Arc welding Maintenance</p> <p>13</p> <p>Repairing / welding of broken cast iron low heat input electrode</p> <p>Any repairing parts Arc welding Maintenance</p> <p>14</p> <p>Bronze weld & single vee butt joint and cast iron Cast-iron 50x7x150 Arc welding Arc brazing</p> <p>15</p> <p>Square butt joint on stainless steel in flat position. S.S. strip 50x5x150 Arc welding</p> <p>16</p>
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<p>Brazing:-</p> <p>Definition – Difference from soldering – Braze welding and welding- Principle of operation-Brazing Procedure- Surface cleaning- Brazing joint Design- Base metal brazed-Brazing fillers alloys- Brazing flux and atmospheres- Function and constitutes of fluxes- Advantages- Limitation and Application of brazing- Brazing Processes- Torch- Furnace –Vacuum-Induction –Dip Resistance- Infrared carbon arc- Flow and block Brazing –Sliver brazing – Alloys-Flux- Brazing methods- Advantages-Disadvantages and application.</p>	<p>Hard surfacing & surface by use & hard surfacing electrode Any repairing parts Arc welding Maintenance</p> <p>17</p> <p>Gas cutting by machine any circles and sizes M.S. sheet 2'x3' Gas cutting Machine process</p>
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<p>Soldering :-</p> <p>Introduction- Comparison of soldering- Brazing and welding- Definition of soldering- Principle of good soldering process- Soldering joint design –Soldering alloys – Selection of Soldering alloys- Soldering fluxes- Cleaning the base metal surfaces – Soldering methods – Soldering iron- Torch tip- Dip- Wave- Induction – Resistance – Furnace- Hot plate- Spray- Ultrasonic and condensation methods – soldering various materials such as carbon and low alloy steel- Cast Iron – Copper and its alloys – Nickel alloys – Aluminum and its alloys.</p> <p>Welding at site</p> <p>Introduction-Site welding v/s shop welding- Welding operator force – Tools- Equipment and facility – Environmental effects on site welding – Site welding quality control.</p> <p>Oxy-hydrogen & other fuel gas welding:-</p> <p>Introduction – Hydrogen – Propane, Butane & Natural gas – Air acetylene welding.</p> <p>Oxy-acetylene cutting:-</p> <p>Introduction – Equipments – Torch – Cutting tips – Regulators – gases – oxygen – fuel gases – Acetylene – natural gas & propane – oxyacetylene cutting techniques</p>	<p>18 Arc gouging electrodes M.S. strip 75x3 Arc cutting Arc cutting</p> <p>19 Square butt joint on aluminum sheet.</p> <p>Alu strip 50x3 Tig welding Advanced</p> <p>20 Square butt joint on Mild steel M.S. 50x5 CO₂ welding Advanced</p> <p>21 Fillet weld T joint position flat M.S. 50x5 CO₂ welding Advanced</p> <p>22 Fillet weld lap joint position horizontal M.S. 50x5 CO₂ welding Advanced</p> <p>23 Fillet weld out side & inside corner position vertical M.S. 50x5 CO₂ welding Advanced</p>
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<p>– Manual Cutting – Edge Start – piecing start – cutting sheet metal – Cutting quality – coupling distance – Cutting speed - Torch movement – Tip angle KERF – Drag – Applications.</p>	
<p>Arc welding processes & Equipments:-</p> <p>Tig or GTAW Welding:</p> <p>Definition – Principle of operation – Equipments – Power source – torch – shielding gas supply – Influence of current & polarity on bead geometry- Selection of GTAW shielding gas- Base metals welded- Carbon and alloy steels – stainless steel – Heat resisting alloys – Magnesium alloys – Nickel alloys etc. GTAW parameters for stainless steel sheets. Joint designs – Advantages – Disadvantages - Applications.</p> <p>Plasma Welding: Process fundamentals – Advantages – Disadvantages – Process Techniques – Key hole mode – Melt in Mode – Equipments – Plasma welding. Filler metals – Micro plasma welding – safety in plasma welding.</p>	<p>1] Fillet weld open corner joint on aluminum sheet Alu. strip 50x3 TIG welding</p> <p>2] Fillet welds tee & lap joint on aluminum. Alu. strip 50x3 TIG welding</p> <p>3] Square butt joint on stainless steel sheet. S.S. strip 50x3 TIG welding</p> <p>4] Fillet weld open & corner joint on S. S. sheet S.S. strip 50x3 TIG Welding</p> <p>5] Butt weld square butt joint on S. S. tube. S.S. tube TIG welding</p>

<p>MIG or GMAW Welding:</p> <p>Process fundamentals – Principle of operation – Equipments and accessories – self adjusted arc self controlled arc – wire burn off characteristics – wire feeders – Mig torch – shielding gases – Argon</p> <p>– Helium – Carbon-dioxide – shielding gas mixtures – Metal transfer – Dip Transfer – Globular transfer – Spray transfer – Repelled transfer – Classification of consumables. Flux-cored Arc Welding: Equipments – Metal Transfer in FCAW – classification of flux cored wires – deposition rate & efficiency.</p> <p>GMA Narrow Gap Welding:</p> <p>Definition – Principle of operation – Applications. Electro Gas Welding – synergic pulsed MIG Welding – Defects – Causes & Preventions. Porosity – Spatter – Lack of fusion – Lack of penetration.</p> <p>CO₂ Welding:-</p> <p>Introduction – Principle of operation – welding equipment welding variables & parameters – electrode size – welding current – Arc voltage – Arc travel speed – Electrode position – Forehand – Backhand – vertical – Joint design – Welding procedure – advantages – Disadvantages – Applications.</p>	
<p>Electro Slag Welding:-</p> <p>Operation – Equipment – Consumables – fluxes – welding operating – welding parameters – coefficient of form factor – Mass balance equation – Effect of welding parameters – Monogram of wire feed rate – Defects – Causes & remedy – Process Limitation – Advantages – Applications.</p> <p>Electro gas Welding:-</p> <p>Definition – Difference between electro slag & electro gas welding – Metal welded by electro gas process – principle of operation – Equipments – Advantages – Disadvantages – Applications.</p> <p>Arc Spot Welding:- Definition – Principles of operation –</p>	

<p>Process description – Welding parameters – Equipments – Difference from Tig welding & electric resistance spot welding – Advantages – Limitations – Applications.</p> <p>Stud Welding:- Definition & Concept – classification – Principle of operation – equipment – Stud welded metals – advantages – Limitations – Applications.</p>	
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<p>Resistance Welding:-</p> <p>Definition – Fundamentals of electric resistance welding – variables in resistance welding – advantages of resistance welding – disadvantages of resistance welding – applications of resistance welding.</p> <p>Spot Welding Introduction and use – Definition – Procedure – Heat Shrinkage in Spot Welding – Heat Balance in Spot Welding – Spot weld able materials – spot welding materials – advantages of spot welding – application of spot welding – spot welding equipments – introduction – basic elements – rocker arm m/c – press type m/c – portable spot welding machine – multiple electrode m/c – power sources for spot welders – direct and store energy type – spot welding electrodes – their functions – requirements – electrode materials and electrode shapes.</p> <p>Seam Welding:-</p> <p>Definition – Principle of operation – Equipments – Metals welder – advantages – disadvantages – applications.</p> <p>Projection Welding:-</p> <p>Definition – Principle of operation – Equipments – Metals welded – advantages – disadvantages – applications.</p> <p>Resistance (upset) butt welding:</p> <p>Definition and concept- Principle of operation- Metals of Welded- Equipments and applications- Flash butt welding- Introduction- Definition- Principle of operation- Metals welded- Equipment- Difference from upset welding- Advantages- Disadvantages and applications of flash butt welding.</p> <p>Percussion Welding: - Definition- Principle of operation- Power supplies- Metals welded- Advantages- Limitations.</p> <p>Resistance Welding of Tubes:- Introduction- rocedure- Advantages and applications- High frequency welding of tubes- Concept and comparison with ERW- Procedure and applications.</p>	<p>6] Straight line & curved line cutting & S. S. S.S. plate 2'x3' Plasma cutting</p> <p>7] Resistance spot welding on M S sheet M.S. strip 25x3 Resistance welding</p> <p>8] Resistance spot welding on G I sheet G.I. Sheet 2'x4' Resistance welding</p> <p>9] Resistance spot welding on hot roller sheets.</p> <p>10] Hot roller sheet Resistance welding Square butt joint position flat Copper & copper alloy TIG welding</p> <p>11] Square butt joint position flat Nickel TIG welding</p>
<p>Solid State Welding Processes:-</p> <p>a) Cold (pressure) welding: Definition- Mechanism- Materials welded- Base metal surface cleaning- Joint</p>	<p>1 Square butt joint position flat Titanium TIG welding</p> <p>2</p>

<p>design- Equipment and applications.</p> <p>b) Diffusion (Bonding) welding): Definition- Theory- Methods- Welding parameters- Materials Welded- Advantages- Limitations and applications of diffusion welding.</p> <p>c) Ultrasonic Welding: Definition- Concept- Principle of operation- Metallurgy of ultrasonic welds- Welding equipments- Welding variables- Types of ultrasonic welds- Materials ultrasonically welded- Advantages- Disadvantages and applications.</p>	<p>Straight line beads position Flat Aluminum sheet only thin surface</p> <p>TIG welding</p> <p>3 Square butt joint position flat Steel & steel alloy MIG welding (flux cored)</p> <p>4 Square butt joint position flat Copper & copper alloy MIG welding (argon)</p> <p>5 Square butt joint position flat Titanium & Zirconium MIG welding (argon)</p>
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<p>Friction Welding and Inertia Welding:- History- Definition- Difference between friction welding and inertia welding- Operational steps in friction welding- Operational steps in inertia welding- Fiber flow in friction and inertia welds- Welding variables- Parameters for inertia welds- Materials welded- Joint preparation- Advantages- Disadvantages of friction/inertia welding.</p> <p>Forge Welding:- Introduction- Metals Welded- Fuel and furnaces required- Surface preparation- Procedure and type of fore welding- Flux requirements- Advantages- Disadvantages- Applications of forge welding.</p> <p>Thermo Chemical Welding Processes:-</p> <p>A)Thermit Welding : History- Definition- Principle of Operations- Thermit Welding Mixtures- Various methods of thermit welding- Procedure of thermit welding- Advantages- Limitations- Uses and applications.</p> <p>B) Atomic Hydrogen Welding: Definition- Principle of operation- Equipments-Advantages- Disadvantages- Applications.</p> <p>Radiant Energy Welding Processes:- Electron Beam Welding: Introduction- Definition- Principle of operation- Welding equipment- Process variables- Safety in electron beam welding- Advantages- Disadvantages- Applications Laser Beam Welding: - Definition and concept- Principle and theory operation- Forms of lasers- Joint design- Advantages- Disadvantages- Applications and safety of laser beam welding.</p> <p>Welding of different metals</p> <p>Welding of Cast Iron:- Introduction- Welding of gray cast iron- Welding characteristics – Processes and techniques for welding gray C.I.- Metal arc welding- Welding electrode used- Oxy acetylene welding- Braze Welding- Brazing and thermit welding of gray C.I.- Welding of malleable C.I.- Welding of nodular C.I.- Welding of alloy C.I.</p> <p>Welding Carbon Steels:-</p> <p>Introduction- Welding of low carbon steels- Welding of medium carbon steels- Welding of high carbon steels-</p>	<p>6 Square butt single V butt joint (position vertical) M.S. flat 50x20x600 Electro slag welding</p> <p>7 Square butt single V butt joint (position flat) M.S. flat 50x20x60 Submerged arc welding</p> <p>8 Square butt joint S.S. Only sheet Plasma welding</p> <p>9 Laser welding* Can be perform in Industry Laser welding</p> <p>10 Laser Cutting* Can be perform in Industry Laser welding</p>
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<p>Welding of steel castings. Welding of Alloy Steels:- Introduction to alloy steels- Effect of alloy elements- Welding of low alloy high strengths. Welding of Tool Steels:- Introduction- Need for – Weldability- Welding processes used-. Welding of Stainless Steels:- Introduction to stainless steels- Austenitic – Ferritic- and martens tic stainless steels- Welding of austenitic stainless steel- Weldability consideration and welding and brazing processes used- Welding of straight chromium- Ferritic and martens tic stainless steels- Welding characteristics and welding processes.</p>	
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<p>Welding tool and die steels:- Types of tool and die steels, Welding tools and dies- Tool and die welding processes- Tool and die arc welding procedure- Composite tool and die fabrication- Silver brazing application and carbide</p> <p>tipping</p> <p>Welding of copper and its alloys:- Introduction- Copper and its alloys- Weldability and welding characteristics of copper and its alloys- Welding processes for copper such as tig-mig and gas welding and brazing-Welding of</p> <p>high copper alloys- Welding of bronzes- Welding of phosphor bronze- Aluminum bronze- Silicon Bronze- Copper nickels- .</p> <p>Welding Pipes, tubes, pressure vessels:- Tubing and pipe manufacturing methods- Pipe line welding- Pipe</p> <p>line weld- Pipe fittings for welded joints- Pipe flange- Pipe templates- Backing rings- Arc welding procedure- Oxy Acetylene procedure- Position welds- Making a rolling weld in two inch pipe- Air craft welding- Types of joints- Oxy acetylene welding procedure- Making butt welds in tubing- Making weld in “T” joints- Making composite joints- Welding pressure vessels- Electrodes used in pressure vessel welding- Surface preparation- Welding procedure- Weld inspection- Plastic pipe welding- Hot air welding- Hot ring welding.</p> <p>Welding Aluminum and Aluminum Alloys:- Welding problems- Aluminum alloys- Welding methods- aluminum identification system- Gas welding of aluminum- Selection of tip size- Flame adjustments- Using a flux – Choice of welding rod- Pre heating- Welding castings- Gas bead welds- Wrought aluminum gas but welds- Cleaning and Finishing Welds- Metal arc welding of aluminum- Flux for metal arc welding- Metal arc welding procedure- Metal Arc Butt welds- Lap welds- Fillet Welds- Resistance spot welding of aluminum- Resistance seam welding of aluminum- Carbon arc welding of aluminum- Current values- Atomic hydrogen welding of aluminum- Tig welding aluminum and</p> <p>Mig welding of aluminum.</p>	<p>Other than above practical Suitable practical based on the Theory topic not covered in above practical should be taken.</p>
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List of Books

- 1 Welder's Guide and Hand Book James E, Brumgaugh
- 2 Text book of Welding technology O.P.Khanna
- 3 Indian Welding Engineering Institute Handbook
- 4 Industrial Welding reference book by NIMI Chennai
- 5 Forging and Welding Robert E Smith
- 6 Principle of welding technology Gourd L M
- 7 Welding & welding technology Little R L
- 8 Welding Technology O.P. Khanna Dhanpat Rai
- 9 Welding Technology Preetam Thakur Royal Book Depot
- 10 Welding Simplified Sethi P.B. Publications
- 11 Welding CIMI Set
- 12 Structural Welding V.K. Chavan Dhanpat Rai and Sons
- 13 Welding and Cutting S.J. Driver Percival Marshall and Co. Ltd, London
- 14 Welding Engineering K.N.Gupta New Height Publisher, Delhi
- 15 Electric Slag Welding B.Paton Foreign Languages Publishing house, Moscow
- 16 Advanced Welding Processes Alexander, Kunzestor MIR Publishers, Moscow
- 17 Welder Trade Theory G.S.Sethi R.B. Publications, New Dehli
- 18 Welding and Welding Technology Richard L Little TataMCgraw hill Publishing Co New Delhi.
- 19 Gas Welding –I Felix Wuttke Asia Publishing House, Bombay
- 20 Welding Engineer's Hand Book J.a.Oates D.B. Taraporwala Sons and Co. Ltd., Bombay-1
- 21 Resistance Welding A. Kuznestor MIR Publishers, Moscow
- 22 Welding Advanced Technology H. Singh Royal Publication

List of Tools and Equipments

- 01 Gloves pair lather 20 Pairs
- 02 Apron leather 20 Nos
- 03 Screen welding helmet type 10 Nos
- 04 Screen Welding hand 10 Nos
- 05 Goggles pair welder (Coloured glass) 10 Nos
- 06 Hammer scaling 0.25 Kg. with handle. Make Taparia 10 Nos
- 07 Chisel cold flat 19 mm. Make Taparia 10 Nos
- 08 Center Punch 9X127mm. Make Taparia 10 Nos
- 09 Dividers 20 cm Make Taparia 10 Nos
- 10 Caliper outside 15 Cm. Make Taparia 10 Nos
- 11 Rule 60 cm two fold brass tipped to read inches and mm. Make Crystal 10 Nos
- 12 Wire brush (M.S) 20 Nos
- 13 Spark Lighter 10 Nos
- 14 Chipping screen hand 08 Nos
- 15 Safety boot for welders 10 Nos
- 16 Safety goggles 10 Nos
- 17 Square blade 15 cm. Make Jelani 08 Nos
- 18 Scriber 15 cm. Make Jelani 08 Nos
- 19 Tong holding 30 cm. Make Jelani 12 Nos
- 20 Wire Brush (S.S.) 20 Nos
- 21 Hammer ball pin 1 kg. with handle. Make- Taparia 04 Nos
- 22 Chisel cold cross 9 mm. Make- Taparia 01 No
- 23 Screw driver 25 cm blade and 20 cm Make- Venus 01 NOs
- 24 Leg Vice on stand 150 mm. Make - Venus 01 Nos
- 25 Number punch 6 mm and letter punch 6mm. Make Venus 04 NOs
- 26 Hack Saw frame adjustable 30 cm. Make Venus 02 Nos
- 27 Hammering blocks 5 cm thick 60 squarer. Make - Venus 02 Nos
- 28 Magnifying Glass X6 03 NOs
- 29 Weld measuring gauge fillet and butt 02 Nos

- 30 File half round battered 30 cm Make JK 06 Nos
- 31 File flat 35 cm rough. Make JK 06 Nos
- 32 Spanner 12 mm and 15 mm double ended. Make Jelani 02 Sets
- 33 Spanner De 6 mm to 15 mm set of nos. Make Jelani 01 Set
- 34 Clamps 10,15,20,30 cm One each
- 35 Hammer sledge double faced 3 kg. Make Taparia 01 each
- 36 Pipe wrench 25 cm and 35 cm. make Tiger 01 Each
- 37 Steel tape 182 cm flexible in case 01 each
- 38 Tinmans square 60cm X 30 cm 01 No.
- 39 Welding torches with 10 nozzles. Make Esab 02 sets
- 40 Eutalloy micro flow powder welding process. Make Esab 01 Kit
- 41 Rototec powder welding process. Make Esab 01 Kit
- 42 Earth clamps. Make- Esab 08 Nos
- 43 Pipe cutter. Make- Esab 01 set
- 44 Cutting torch oxy- acetylene with cutting nozzle. Make- Esab 02 set
- 45 Heavy duty cutting, blow pipe with cutting. Make- Esab 01 set
- 46 Electrode holder 400 ams. Make- Esab 06 Nos
- 47 Welding rubber hose pipe oxygen and acetylene dia 8 mm. Make- Esab 30 meters
- 48 Rubber hose clips. Make- Esab 24 Nos
- 49 Tip cleaner 08 No
- 50 Spindle key (for opening cylinder valve) Make- Esab 04 No
- 51 Pressure regulator oxygen two stages. Make- Esab 03 no
- 52 Pressure regulator acetylene two stages. Make- Esab 03 No
- 52 Coloured glass for welding screen. 108X82X3mm Make Din. 11A, 9A, 13 A. 25 No
- 53 White glass for welding screen. 108X82X3mm 50 No
- 54 Outfit spanner double ended or single ended. Make Esab 02 No
- 55 Rubber hose pipe black and red dia 5mm Make Esasb 30 meter
- 56 Leather sleeves 20 pair
- 57 Welding Cable to be carry 400 Amps with flexible rubber 30 meters

Welding Machines

01 Arc Welding Transformer set with all accessories, 300 Amps and safety requirements.
Ador make One Set

02 Arc welding Set Rectifier type 400 Amps with all accessories and all safety equipments.
M.M.A. welding rectifier model power con. 400 Amps. Ador Make One Set

03 Oxy acetylene gas welding plant with cylinder trolley and all safety requirements. (Esab Make) and pug cutting machine. Straight and circle attachment with standard accessories.
One Set

04 Oxy Acetylene gas cutting plant with cylinder trolley with safety requirements. (Esab make) One Set

05 Arc welding machines and carbon arc welding machines. One Set

06 Tig welding set complete 300 Amps. Ac/DC. Tig welding outfit model Adortig, Ad-25/30 with all accessories and safety requirements (Ador make) One Set

07 Co2 welding machine complete 400 amps (Invertors type) MIG machine model champing, 400 Amps, Ador make with accessories and safety requirements. One Set

08 Air Plasma cutting and welding machine- Model PAC 50/100/150 Features-a) High speed manual or mechanical cutting of 12.5mm/25mm/40 mm plates of any metal.

b) Greater productivity

c) Power factor corrected- lower operation cost due to lower input draw.

e) Pressure switch to prevent torch. Damage with all accessories and safety requirements.

Make- Pro Arc welding and cutting systems Pvt. Ltd. One Set

09 Resistance Welding Process Machine- Model spot projection seam welding.

Feature:- a) Rugged and Reliable spot, seam and projection welding machine.

b) CRMOS micro processor based controls.

c) Thyristorised controlled highly accurate and consistent performance. Make- Pro Arc Welding and Cutting Systems Pvt. Ltd. One Set

10 Submerged Arc Welding Machine 600Amps outfit model. Masetro 600 with standard accessories with safety requirements. One Set

11 Electro slag welding machine with standard accessories with safety requirements One Set

12 Micro Plasma Welding Machines 25 Amps main voltage 1X 230 volts Resp 3X300 VtN type fuses slow (A) 16/32. Make- Pro Arc Welding and cutting systems Pvt. Ltd. With standard accessories with safety requirements. One Set

13 Laser Welding Machine and Laser Cutting Machine- 5 Axis C.N.C. laser welding capacity 1.7 K.W. make prima with standard accessories and safety requirements. One Set

14 Ultrasonic Welding Machine with the following accessories

a) Frequency converter

b) Transducer coupling system.(Sonotrode)

c) Anvil

One Set

d) Force Application device.

e) Timer with appropriate electrical/electronics and hydraulic pneumatic control.

15 Thermit Welding machine with all accessories 01 No

16 Electron Beam Welding System. 01 No.

16 C.N.C. profile cutting machine: Model PCNC 2002/3 with all accessories and safety equipments. Make- Pro Arc Welding and Cutting Equipments Systems. One Set

17 Bench shear hand capacity up to 5mm. Make- Ravi. 01 No.

18 D.E. Grinder 30 cm wheel motorized pedestal type machine. 2 HP,440V, 1440 RPM wheel, 300mm X 40 mm. Make- E/moco. 01 No.

19 Power Hack Saw Machine- Bandsaw type, Horizontal with motor. Make – Lipson 01 No

20 Electrode drying oven- Temperature range 0-250 degree Celsius, 10 kg capacity drying oven model. Adoredry-I . Make – Ador. 01 No

21 AG-7 Grinder AG 4 with standard accessories 01 No

22 Portable Drilling Machine – Capacity 6mm, with standard size drill and Allanquie. Make-WOLF 01 No.

Subject Name - Advance Welding Technology and Machines**Subject Code - 30340027**

Theory – 1 st year	Practical – 1 st year
<p>Arc welding processes & Equipments:-</p> <p>Tig or GTAW Welding:</p> <p>Definition – Principle of operation – Equipments – Power source – torch – shielding gas supply – Influence of current & polarity on bead geometry- Selection of GTAW shielding gas- Base metals welded- Carbon and alloy steels – stainless steel – Heat resisting alloys – Magnesium alloys – Nickel alloys etc. GTAW parameters</p> <p>for stainless steel sheets. Joint designs – Advantages –</p> <p>Disadvantages - Applications.</p> <p>Plasma Welding: Process fundamentals – Advantages –</p> <p>Disadvantages – Process Techniques – Key hole mode – Melt in Mode – Equipments – Plasma welding. Filler metals – Micro plasma welding – safety in plasma welding.</p>	<p>1] Fillet weld open corner joint on aluminum sheet Alu. strip 50x3 TIG welding</p> <p>2] Fillet welds tee & lap joint on aluminum. Alu. strip 50x3 TIG welding</p> <p>3] Square butt joint on stainless steel sheet. S.S. strip 50x3 TIG welding</p> <p>4] Fillet weld open & corner joint on S. S. sheet S.S. strip 50x3 TIG Welding</p> <p>5] Butt weld square butt joint on S. S. tube. S.S. tube TIG welding</p>
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<p>CO₂ Welding:-</p> <p>Introduction – Principle of operation – welding equipment welding variables & parameters – electrode size – welding current – Arc voltage – Arc travel speed – Electrode position – Forehand – Backhand – vertical – Joint design – Welding procedure – advantages – Disadvantages – Applications.</p>	
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<p>Resistance Welding:-</p> <p>Definition – Fundamentals of electric resistance welding – variables in resistance welding – advantages of resistance welding – disadvantages of resistance welding – applications of resistance welding.</p> <p>Spot Welding Introduction and use – Definition – Procedure – Heat Shrinkage in Spot Welding – Heat Balance in Spot Welding – Spot weld able materials – spot welding materials – advantages of spot welding – application of spot welding – spot welding equipments – introduction – basic elements – rocker arm m/c – press type m/c – portable spot welding machine – multiple electrode m/c – power sources for spot welders – direct and store energy type – spot welding electrodes – their functions – requirements – electrode materials and electrode shapes.</p> <p>Seam Welding:-</p> <p>Definition – Principle of operation – Equipments – Metals welder – advantages – disadvantages – applications.</p> <p>Projection Welding:-</p> <p>Definition – Principle of operation – Equipments – Metals welded – advantages – disadvantages – applications.</p> <p>Resistance (upset) butt welding:</p> <p>Definition and concept- Principle of operation- Metals of Welded- Equipments and applications- Flash butt welding- Introduction- Definition- Principle of operation- Metals welded- Equipment- Difference from upset welding- Advantages- Disadvantages and applications of flash butt welding.</p> <p>Percussion Welding: - Definition- Principle of operation- Power supplies- Metals welded- Advantages- Limitations.</p> <p>Resistance Welding of Tubes:- Introduction- rocedure-</p> <p>Advantages and applications- High frequency welding of tubes- Concept and comparison with ERW- Procedure and applications.</p>	<p>6] Straight line & curved line cutting &</p> <p>S. S. S.S. plate 2'x3' Plasma cutting</p> <p>7] Resistance spot welding on M S sheet M.S. strip 25x3 Resistance welding</p> <p>8] Resistance spot welding on G I sheet G.I. Sheet 2'x4' Resistance welding</p> <p>9] Resistance spot welding on hot roller sheets.</p> <p>10] Hot roller sheet Resistance welding Square butt joint position flat</p> <p>Copper & copper alloy TIG welding</p> <p>11] Square butt joint position flat Nickel TIG welding</p>
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<p>Solid State Welding Processes:-</p> <p>a) Cold (pressure) welding: Definition- Mechanism- Materials welded- Base metal surface cleaning- Joint design- Equipment and applications.</p> <p>b) Diffusion (Bonding) welding): Definition- Theory- Methods- Welding parameters- Materials Welded- Advantages- Limitations and applications of diffusion welding.</p> <p>c) Ultrasonic Welding: Definition- Concept- Principle of operation- Metallurgy of ultrasonic welds- Welding equipments- Welding variables- Types of ultrasonic welds- Materials ultrasonically welded- Advantages- Disadvantages and applications.</p>	<p>1 Square butt joint position flat Titanium TIG welding</p> <p>2</p> <p>Straight line beads position Flat Aluminum sheet only thin surface TIG welding</p> <p>3 Square butt joint position flat Steel & steel alloy MIG welding (flux cored)</p> <p>4 Square butt joint position flat Copper & copper alloy MIG welding (argon)</p> <p>5 Square butt joint position flat Titanium & Zirconium MIG welding (argon)</p>
<p>Friction Welding and Inertia Welding:- History- Definition- Difference between friction welding and inertia welding- Operational steps in friction welding- Operational steps in inertia welding- Fiber flow in friction and inertia welds- Welding variables- Parameters for inertia welds- Materials welded- Joint preparation- Advantages- Disadvantages of friction/inertia welding.</p> <p>Forge Welding:- Introduction- Metals Welded- Fuel and furnaces required- Surface preparation- Procedure and type of fore welding- Flux requirements- Advantages- Disadvantages- Applications of forge welding.</p> <p>Thermo Chemical Welding Processes:-</p> <p>A)Thermit Welding : History- Definition- Principle of Operations- Thermit Welding Mixtures- Various methods of thermit welding- Procedure of thermit welding- Advantages- Limitations- Uses and applications.</p> <p>B) Atomic Hydrogen Welding: Definition- Principle</p>	<p>6 Square butt single V butt joint (position vertical) M.S. flat 50x20x600 Electro slag welding</p> <p>7</p> <p>Square butt single V butt joint (position flat) M.S. flat 50x20x60 Submerged arc welding</p> <p>8 Square butt joint S.S. Only sheet Plasma welding</p> <p>9 Laser welding* Can be perform in Industry Laser welding</p> <p>10 Laser Cutting* Can be perform in Industry Laser welding</p>

<p>of operation- Equipments-Advantages-Disadvantages- Applications.</p> <p>Radiant Energy Welding Processes:- Electron</p> <p>Beam Welding: Introduction- Definition- Principle of operation- Welding equipment- Process variables- Safety in electron beam welding- Advantages- Disadvantages- Applications Laser Beam Welding: - Definition and concept- Principle and theory operation- Forms of lasers- Joint design- Advantages- Disadvantages- Applications and safety of laser beam welding.</p> <p>Welding of different metals</p> <p>Welding of Cast Iron:- Introduction- Welding of gray cast iron- Welding characteristics – Processes and techniques for welding gray C.I.- Metal arc welding- Welding electrode used- Oxy acetylene welding- Braze Welding- Brazing and thermit welding of gray C.I.- Welding of malleable C.I.- Welding of nodular C.I.- Welding of alloy C.I.</p> <p>Welding Carbon Steels:-</p> <p>Introduction- Welding of low carbon steels- Welding of medium carbon steels- Welding of high carbon steels- Welding of steel castings. Welding of Alloy Steels:- Introduction to alloy steels- Effect of alloy elements- Welding of low alloy high strengths. Welding of Tool Steels:- Introduction- Need for – Weldability- Welding processes used-. Welding of Stainless Steels:- Introduction to stainless steels- Austenitic – Ferritic- and martens tic stainless steels- Welding of austenitic stainless steel- Weldability consideration and welding and brazing processes used- Welding of straight chromium- Ferritic and martens tic stainless steels- Welding characteristics and welding processes.</p>	
<p>Welding tool and die steels:- Types of tool and die steels, Welding tools and dies- Tool and die welding processes- Tool and die arc welding procedure- Composite tool and die fabrication- Silver brazing application and carbide</p> <p>tipping</p> <p>Welding of copper and its alloys:- Introduction- Copper and its alloys- Weldability and welding characteristics of copper and its alloys- Welding processes for copper such as tig-mig and gas welding</p>	

<p>and brazing-Welding of</p> <p>high copper alloys- Welding of bronzes- Welding of phosphor bronze- Aluminum bronze- Silicon Bronze- Copper nickels- .</p> <p>Welding Pipes, tubes, pressure vessels:- Tubing and pipe manufacturing methods- Pipe line welding- Pipe</p> <p>line weld- Pipe fittings for welded joints- Pipe flange- Pipe templates- Backing rings- Arc welding procedure- Oxy Acetylene procedure- Position welds- Making a rolling weld in two inch pipe- Air craft welding- Types of joints- Oxy acetylene welding procedure- Making butt welds in tubing- Making weld in “T” joints- Making composite joints- Welding pressure vessels- Electrodes used in pressure vessel welding- Surface preparation- Welding procedure- Weld inspection- Plastic pipe welding- Hot air welding- Hot ring welding.</p> <p>Welding Aluminum and Aluminum Alloys:-</p> <p>Welding problems- Aluminum alloys- Welding methods- aluminum identification system- Gas welding of aluminum- Selection of tip size- Flame adjustments- Using a flux – Choice of welding rod- Pre heating- Welding castings- Gas bead welds- Wrought aluminum gas but welds- Cleaning and Finishing Welds- Metal arc welding of aluminum- Flux for metal arc welding- Metal arc welding procedure- Metal Arc Butt welds- Lap welds- Fillet Welds- Resistance spot welding of aluminum- Resistance seam welding of aluminum- Carbon arc welding of aluminum- Current values- Atomic hydrogen welding of aluminum- Tig welding aluminum and</p> <p>Mig welding of aluminum.</p>	
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Theory – 2 nd year	Practical – 2 nd year
<p>Arc Welding Machines</p> <p>1) Introduction- Fundamental of power sources, Classification of welding machines, A.C. Welding machine (Transformer) principle, construction, specification, application, operation, constant current and constant voltage, characteristics.</p> <p>2) Types of current control.</p> <p>a) movable coil type,</p> <p>b) movable shunt type,</p> <p>c) series induction control,</p> <p>d) taped secondary coil control,</p> <p>e) magnetic amplifier control,</p> <p>D.C. welding machines rectifiers, principle construction, single phase and three phase, transformers, rectifiers circuit, operation.</p> <p>3) Welding generators.,</p> <p>a) control rheostat,</p> <p>b) Shunt coil</p> <p>c) Motors</p> <p>d) Generator commutators.</p> <p>e) Repairs and maintenance.</p> <p>TIG Welding Machine</p> <p>1) Introduction, specification, application .Electronic Type D.C. Welding machine. Thyristor welding power sources.</p> <p>a) Thyristor rectifier</p> <p>b) Feed back system.</p> <p>2) Transistor control welding power sources.</p> <p>a) transformer</p> <p>b) Transistor bank</p> <p>c) Inverter type power sources</p>	<p>1 Study of Welding of transformer</p> <p>2 Study of current adjusting tapped method.</p> <p>3 Study of moving coil method</p> <p>4 Study of moving core method</p> <p>5 Study of welding rectifier</p> <p>6 Study of welding generator</p> <p>7 Study of spot welding controller</p> <p>8 Study of high frequency unit</p> <p>9 Study of D C suppressor</p> <p>10 Study of holding devices used in friction welding</p> <p>11 Study of principle of inverter</p> <p>12 Study of solenoid valves used in Gas Metal Arc Welding</p> <p>13 Study of variation of current and weld width</p> <p>14 Study of welding by AC & DC welding machine</p> <p>15 Study of flow chart of water circulation in Resistance Spot welding</p>

<p>3) Accessories for power sources.</p> <p>a) Remote regulator</p> <p>b) D.C. suppressor</p> <p>c) High frequency unit.</p> <p>4) Repairs and Maintenance</p> <p>Solid States Welding Machines</p> <p>1) Ultrasonic welding machines</p> <p>a) A frequency converter</p> <p>b) A transistor coupling system, an anvil.</p> <p>c) A force application device, a timer</p> <p>d) appropriate electrical, electronic and hydraulic/pneumatic controls.</p> <p>2) Friction Welding.</p> <p>a) Conventional drive sources.</p> <p>b) Holding devices</p> <p>c) Transmission system</p> <p>d) De- accelerating devices.</p> <p>3) Repairs and Maintenance</p>	
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<p>Resistance Welding Machines.</p> <p>1) Specification, application, Introduction to welding machines.</p> <p>a) Welding transformers.</p> <p>b) Welding controller</p> <p>c) Water circulating unit.</p> <p>d) Air cylinders and fittings.</p> <p>e) Solenoid valve.</p> <p>f) Type of spot welding machines.</p> <p>g) Welding electrodes, its types, design and material.</p> <p>2) Repairs and Maintenance</p> <p>Selection of Welding Machine</p> <p>Material to be joined ferrous- non ferrous, thickness joint configuration Position of welding</p> <p>Current output Manual -semi automatic- automatic</p> <p>Volume of production Types of welding current AC/DC Risk in Operating and process.</p>	<p>1</p> <p>Study of setting of parameters (voltage) on Radiographic Testing</p> <p>Machine</p> <p>2 Study comparison of force and rpm of Friction welding machine</p> <p>3 Study of setting of frequency in Ultrasonic welding machine</p> <p>4</p> <p>Study of setting of current as per the dia of wire in Submerged Arc</p> <p>Welding</p>
<p>Thermo-Chemical Welding machines.</p> <p>a) Introduction, construction, specification, Thermit welding, module box and its details, sand its preparation, crucible molten metal releasing mechanism, repairs and maintenance.</p> <p>b) Introduction, construction, specification, Automatic Hydrogen welding – Transformers, electrode holder,hydrogen gas feeding system. repairs and maintenance</p> <p>Radiant Energy Welding Machines.</p> <p>A) Electronic Beam Welding- electron gun, vacuum chamber, high voltage transformer, Electronic/Electric controls, cubical chamber, vacuum pump, Gun vacuum pump.</p>	<p>5 Study of principle of Electro slag Welding Machine</p> <p>6 Study of principle of LASER Welding and Cutting machine</p> <p>7</p> <p>Study of different axis of Welding Robots and application of robots for welding</p> <p>8 Study of manifold system of cylinder</p> <p>9 Study of procedure of developing the radiographic film</p> <p>10 Study of reading the ultrasonic tested report of the weld</p> <p>11 Preparation of break down memo of welding machine</p>

<p>B) Laser beam welding, High voltage power supply unit. Reflective mirror, Discharge tube, Gas feeding mechanism.</p> <p>Underwater welding machine</p> <p>Introduction, construction, specification, welding rectifiers, polarities setting, construction of dry chamber, light support system. D.C. Welding set with 300 amp capacity,</p> <p>Fume extraction system</p> <p>Introduction, construction, specification, imperative of fume extraction, vacuum pump, fitting, outlet pipe, dust separation, containers, repairs and maintenance.</p> <p>Welding Manifolds.</p> <p>1) Introduction, construction, specification, necessity of manifold system, master regulator, stage regulator, piping, on off valves. 2) Repairs and maintenance.</p>	
<p>Welding machine installation and commissioning</p> <p>Introduction, power supply, connections, machine settings, megar test, training as per specifications.</p> <p>Welding machine layout.</p> <p>Main supply layout/ output supply Machine location, Switch box, Double earthing to machine, Requirements of movement of machine, installation, welding connections, Access of maintenance , Size of welding machine, System of reporting faults.</p>	

List of Books

- 1 Welder's Guide and Hand Book James E, Brumgaugh
- 2 Text book of Welding technology O.P.Khanna
- 3 Indian Welding Engineering Institute Handbook
- 4 Industrial Welding reference book by NIMI Chennai
- 5 Forging and Welding Robert E Smith
- 6 Principle of welding technology Gourd L M

- 7 Welding & welding technology Little R L
- 8 Welding Technology O.P. Khanna Dhanpat Rai
- 9 Welding Technology Preetam Thakur Royal Book Depot
- 10 Welding Simplified Sethi P.B. Publications
- 11 Welding CIMI Set
- 12 Structural Welding V.K. Chavan Dhanpat Rai and Sons
- 13 Welding and Cutting S.J. Driver Percival Marshall and Co. Ltd, London
- 14 Welding Engineering K.N.Gupta New Height Publisher, Delhi
- 15 Electric Slag Welding B.Paton Foreign Languages Publishing house, Moscow
- 16 Advanced Welding Processes Alexander, Kunzestor MIR Publishers, Moscow
- 17 Welder Trade Theory G.S.Sethi R.B. Publications, New Dehli
- 18 Welding and Welding Technology Richard L Little TataMCgraw hill Publishing Co New Delhi.
- 19 Gas Welding –I Felix Wuttke Asia Publishing House, Bombay
- 20 Welding Engineer's Hand Book J.a.Oates D.B. Taraporwala Sons and Co. Ltd., Bombay-1
- 21 Resistance Welding A. Kuznestor MIR Publishers, Moscow
- 22 Welding Advanced Technology H. Singh Royal Publication

List of Tools and Equipments

- 01 Gloves pair lather 20 Pairs
- 02 Apron leather 20 Nos
- 03 Screen welding helmet type 10 Nos
- 04 Screen Welding hand 10 Nos
- 05 Goggles pair welder (Coloured glass) 10 Nos
- 06 Hammer scaling 0.25 Kg. with handle. Make Taparia 10 Nos
- 07 Chisel cold flat 19 mm. Make Taparia 10 Nos
- 08 Center Punch 9X127mm. Make Taparia 10 Nos
- 09 Dividers 20 cm Make Taparia 10 Nos
- 10 Caliper outside 15 Cm. Make Taparia 10 Nos
- 11 Rule 60 cm two fold brass tipped to read inches and mm. Make Crystal 10 Nos
- 12 Wire brush (M.S) 20 Nos

- 13 Spark Lighter 10 Nos
- 14 Chipping screen hand 08 Nos
- 15 Safety boot for welders 10 Nos
- 16 Safety goggles 10 Nos
- 17 Square blade 15 cm. Make Jelani 08 Nos
- 18 Scriber 15 cm. Make Jelani 08 Nos
- 19 Tong holding 30 cm. Make Jelani 12 Nos
- 20 Wire Brush (S.S.) 20 Nos
- 21 Hammer ball pin 1 kg. with handle. Make- Taparia 04 Nos
- 22 Chisel cold cross 9 mm. Make- Taparia 01 No
- 23 Screw driver 25 cm blade and 20 cm Make- Venus 01 NOs
- 24 Leg Vice on stand 150 mm. Make - Venus 01 Nos
- 25 Number punch 6 mm and letter punch 6mm. Make Venus 04 NOs
- 26 Hack Saw frame adjustable 30 cm. Make Venus 02 Nos
- 27 Hammering blocks 5 cm thick 60 squarer. Make - Venus 02 Nos
- 28 Magnifying Glass X6 03 NOs
- 29 Weld measuring gauge fillet and butt 02 Nos
- 30 File half round battered 30 cm Make JK 06 Nos
- 31 File flat 35 cm rough. Make JK 06 Nos
- 32 Spanner 12 mm and 15 mm double ended. Make Jelani 02 Sets
- 33 Spanner De 6 mm to 15 mm set of nos. Make Jelani 01 Set
- 34 Clamps 10,15,20,30 cm One each
- 35 Hammer sledge double faced 3 kg. Make Taparia 01 each
- 36 Pipe wrench 25 cm and 35 cm. make Tiger 01 Each
- 37 Steel tape 182 cm flexible in case 01 each
- 38 Tinmans square 60cm X 30 cm 01 No.
- 39 Welding torches with 10 nozzles. Make Esab 02 sets
- 40 Eutalloy micro flow powder welding process. Make Esab 01 Kit
- 41 Rototec powder welding process. Make Esab 01 Kit
- 42 Earth clamps. Make- Esab 08 Nos
- 43 Pipe cutter. Make- Esab 01 set

- 44 Cutting torch oxy- acetylene with cutting nozzle. Make- Esab 02 set
- 45 Heavy duty cutting, blow pipe with cutting. Make- Esab 01 set
- 46 Electrode holder 400 ams. Make- Esab 06 Nos
- 47 Welding rubber hose pipe oxygen and acetylene dia 8 mm. Make- Esab 30 meters
- 48 Rubber hose clips. Make- Esab 24 Nos
- 49 Tip cleaner 08 No
- 50 Spindle key (for opening cylinder valve) Make- Esab 04 No
- 51 Pressure regulator oxygen two stages. Make- Esab 03 no
- 52 Pressure regulator acetylene two stages. Make- Esab 03 No
- 52 Coloured glass for welding screen. 108X82X3mm Make Din. 11A, 9A, 13 A. 25 No
- 53 White glass for welding screen. 108X82X3mm 50 No
- 54 Outfit spanner double ended or single ended. Make Esab 02 No
- 55 Rubber hose pipe black and red dia 5mm Make Esasb 30 meter
- 56 Leather sleeves 20 pair
- 57 Welding Cable to be carry 400 Amps with flexible rubber 30 meters

Welding Machines

01 Arc Welding Transformer set with all accessories, 300 Amps and safety requirements.
Ador make One Set

02 Arc welding Set Rectifier type 400 Amps with all accessories and all safety equipments.
M.M.A. welding rectifier model power con. 400 Amps. Ador Make One Set

03 Oxy acetylene gas welding plant with cylinder trolley and all safety requirements. (Esab Make) and pug cutting machine. Straight and circle attachment with standard accessories.
One Set

04 Oxy Acetylene gas cutting plant with cylinder trolley with safety requirements. (Esab make) One Set

05 Arc welding machines and carbon arc welding machines. One Set

06 Tig welding set complete 300 Amps. Ac/DC. Tig welding outfit model Adortig, Ad-25/30 with all accessories and safety requirements (Ador make) One Set

07 Co2 welding machine complete 400 amps (Invertors type) MIG machine model champing, 400 Amps, Ador make with accessories and safety requirements. One Set

08 Air Plasma cutting and welding machine- Model PAC 50/100/150 Features-a) High speed manual or mechanical cutting of 12.5mm/25mm/40 mm plates of any metal.

b) Greater productivity

c) Power factor corrected- lower operation cost due to lower input draw.

e) Pressure switch to prevent torch. Damage with all accessories and safety requirements.

Make- Pro Arc welding and cutting systems Pvt. Ltd. One Set

09 Resistance Welding Process Machine- Model spot projection seam welding.

Feature:- a) Rugged and Reliable spot, seam and projection welding machine.

b) CRMOS micro processor based controls.

c) Thyristorised controlled highly accurate and consistent performance. Make- Pro Arc Welding and Cutting Systems Pvt. Ltd. One Set

10 Submerged Arc Welding Machine 600Amps outfit model. Masetro 600 with standard accessories with safety requirements. One Set

11 Electro slag welding machine with standard accessories with safety requirements One Set

12 Micro Plasma Welding Machines 25 Amps main voltage 1X 230 volts Resp 3X300 VtN type fuses slow (A) 16/32. Make- Pro Arc Welding and cutting systems Pvt. Ltd. With standard accessories with safety requirements. One Set

13 Laser Welding Machine and Laser Cutting Machine- 5 Axis C.N.C. laser welding capacity 1.7 K.W. make prima with standard accessories and safety requirements. One Set

14 Ultrasonic Welding Machine with the following accessories

a) Frequency converter

b) Transducer coupling system.(Sonotrode)

c) Anvil

One Set

d) Force Application device.

e) Timer with appropriate electrical/electronics and hydraulic pneumatic control.

15 Thermit Welding machine with all accessories 01 No

16 Electron Beam Welding System. 01 No.

16 C.N.C. profile cutting machine: Model PCNC 2002/3 with all accessories and safety equipments. Make- Pro Arc Welding and Cutting Equipments Systems. One Set

17 Bench shear hand capacity up to 5mm. Make- Ravi. 01 No.

18 D.E. Grinder 30 cm wheel motorized pedestal type machine. 2 HP,440V, 1440 RPM wheel, 300mm X 40 mm. Make- E/moco. 01 No.

19 Power Hack Saw Machine- Bandsaw type, Horizontal with motor. Make – Lipson 01 No

20 Electrode drying oven- Temperature range 0-250 degree Celsius, 10 kg capacity drying oven model. Adoredry-I . Make – Ador. 01 No

21 AG-7 Grinder AG 4 with standard accessories 01 No

22 Portable Drilling Machine – Capacity 6mm, with standard size drill and Allanquie. Make-WOLF 01 No.