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SYLLABUS FOR Mechanic Machine Tool Maintenance

UNDER
CRAFTSMEN TRAINING SCHEME
&
APPRENTICESHIP TRAINING SCHEME

As approved by
GOVERNMENT OF INDIA

In consultation with
THE NATIONAL COUNCIL FOR
VOCATIONAL TRAINING
&
CENTRAL APPRENTICESHIP COUNCIL

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

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General Information

1. Name of the Trade : Mechanic Machine Tools Maintenance
2. N.C.O. Code No. : 845.50
3. Duration of Craftsmen Training : 2 Years
4. Duration of Apprenticeship Training : 3 Years including one year Basic Training
5. Rebate to Ex-Craftsman Trainees : **TRADE PERIOD**
Millwright/Maintenance : Full
6. Ratio of Apprentice to : 1 : 7

(3)

TRADE SKILLS

S. No.	Area of Training	Present Syllabus (In Weeks)	Proposed Syllabus (In Weeks)				Total
			Years				
			I	II	III	IV	
1.	Basic Bench working skill	18	15	-	-	-	15
2.	Basic machine working skills	12	10	5	-	-	15
3.	Basic hot working skills	6	-	5	-	-	5
4.	Advanced bench working skills	12	5	-	-	-	5
5.	Applications of skills learnt	12	5	2	-	-	7
6.	Skills involved in repairing of machine elements.	20	-	-	12	4	16
7.	Basic skills involved in Mechanical handling m/c for transportation purposes. Leveling & Testing of m/c.	4	3	4	-	-	7
8.	Breakdown maintenance & overhauling of machine.	12	-	3	10	14	27
9.	Training on Industrial Hydraulics & Pneumatics.	12	4	6	-	4	14
10.	Re-conditioning, testing & Installation of machines.	24	-	-	12	18	30
11.	Preventive maintenance.	6	-	2	10	6	18
12.	Skills involved in basic Electrical Technology.	6	2	3	-	-	5
13.	Revision & Test.	12	2	2	2	-	6
14.	CNC		-	4	-	-	4
15.	Electronics		1	1	-	-	2
16.	Pipe fitting		2	-	-	-	2
17.	Sheet Metal Working		-	2	-	-	2
18.	Basic maintenance skill		3	10	6	-	19
19.	Applied machine skill		-	3	-	6	9
Total			52	52	52	52	208

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**SYLLABUS FOR THE TRADE OF "MECHANIC MACHINE TOOL MAINTENANCE"
FOR CRAFTSMEN TRAINING SCHEME**

Period of Training : 3 Years

Practical	Theory	Engineering Drawing	Workshop Calculation & Science
2	3	4	5
CTION arisation with institute and Importance of the trade g, types of the work done Trainee & role of "Ma- Tool Maintenance Me- " in an industry. & Regulations of the Insti- d Safety Rules. ance of cleanliness & iness at the work place. iction to First aid prac- Method of Maintaining d Box.	INTRODUCTION History of Institute – necessary information, guidance to the new comer to get familiarise with the working Institute, rules, proce- dures etc. Recreational, Medical & other fa- cilities available in the institute. Importance of Safety & General precautions to be observed in the Institute & in the section. Safe working habits, importance of good house keeping, cleanliness & orderliness & personal hygiene.	SUBJECT: ENGINEERING DRAWING AIM : ☆ To learn language of engineers. ☆ To Acquire proficiency in interpretation of engineering drawing. ☆ to make the students to prepare working drawing from assembly drawings. ☆ Ability to read CNC drawings.	1–16. Engineering Material : Introduction to Engineering Material. Classification, importance of metallic & non-metallic material, Physical & mechanical properties. Testing of metal. Hardness testing. DRAFT – SYLLABUS FOR MACHINE TOOL SUBJECT – WORKSHOP CALCULATIONS 1-3 COMMON FRACTION :

(6)

2	3	4	5
ing equipments & their hop talk & demonstra- tion with various ols used in the trade. ool box & essential location of work place.	Importance of the trade in the in- dustrial Economy of the Country. What is Related instructions - sub- jects, to be taught, achievements to be made etc.	1. Introduction to graphical language and uses of draw- ing instruments. BIS- Standard sizes of drawing sheets. 2-3. Free hand sketching vertical, horizontal, inclines straight lines and Polygons - Rectangles, Squares, etc.	Need, Introduction & defi- nition. Numerator denomi- nator, Different types. Fun- damental rule. Fundamen- tal operations applied to Fraction, Addition, Subtrac- tion, Multiplication, Divi- sion, Problems for practice.

BENCH WORKING

tion to bench vice, its
tion, operation & main-
Lubrication.

on for filing, Standing
with respect to bench
iling. Marking lines on
urface for filing to the
ines. Gripping the job

n the vice jaws for fil-
ncing of file, using

LINEAR MEASUREMENT

Introduction to measuring &
checking instruments. Linear
measurement by using Steel rule,
Depth rule, Hook rule & Zig Zag
rule, Bit rule tape etc.

Try square, Firm joint caliper,
spring joint caliper & adjustable
bevel protractor, combination set
etc.

Vernier calipers—principle & con-
struction, reading a Vernier
caliper, care & maintenance etc.

(7)

2	3	4	5
ple measuring instru- ch as Steel Rule, Ver- per, Inside/Outside Mi- : Care and Precautions erved in handling these hts. ment by using Inside/ Calipers & Scale. s on measurement of geometrical shapes. s on marking out ac- to simple blue prints, eel rule, scriber, mark- ks and divider.	Vernier height gauge - construc- tion & use, care & maintenance.		
lines on chalked or col- ue) surfaces of the work properly supported against a plate on marking-off an accuracy of + or - 0.5			
location of the posi- oles & scribing circles			

2	3	4	5
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using dividers. Use of Dot & Centre Punch for punching the lines, centres & circles.

Balancing of file, using rough file, Exercise of filing flanges of channel for balancing of file. Filing flat surface & flanges of a channel maintaining parallelism between them using outside calipers within + or - 0.5 mm.

FILES AND FILING

Work bench, Bench vice—different types of vices, constructional details & uses, care & maintenance of vices.

Files & filing—File parts, material & classification—types Grade, Cut, Shape, Length etc.

Pining of file, Convexity of File—reasons reconditioning of files, File care & its uses.

Methods of filing for steady & accurate filing—no. of strokes per minute, right method of fixing file handle, Care & maintenance of files.

MARKING

Introduction to Marking & mark-

4. Freehand Skething, practice of curved lines, Arcs, circles etc.

4-6. DECIMAL FRAC-TIONS

Introduction—how to express Addition & Subtraction, Multiplication & Division.

2	3	4	5
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ing tools—construction, use, care & maintenance.

Surface plate, "V" Block, Angle plate, Marking Block, Engineering Square, Parallel Block, "C" Clamp. Parallel clamps, Scribers Dividers, Hermaphrodite calipers.

PUNCHES

Introduction to punches
Various types of punches such as Center Punch, Dot Punch etc. Use of marking media to Letter & No. punch set, Pin & Hollow Punches—material & uses.

Hammer types, parts, specification & uses.

Fitting the handle to the hammer head, precautions and maintenance.

5-6. Picture plane concent, Diverging and Converging projections.

2	3	4	5
Helism between opposite & reducing thickness.			

cises on filing for maintain-
imensions within + or - 0.1
using Vernier Caliper. Fil-
with Second Cut file to pre-
smooth surfaces.

ing of profiles - combina-
of straight lines, circles, arcs
gles using Scale, Divider,
ier Height Gauge, Protrac-
Combination Set etc.

ing on the job piece for
uts. Gripping the job suit-
n the vice jaws for hack-
g to dimensions.

nering practice on verti-
eld round job. Blind ham-
g practice.

HACKSAW & HACKSAWING

Types of Hacksaw frames - dif-
ferent carts. Types of Hacksaw
blades & their material, specifica-
tion and uses. Reasons for break-
ing of hacksaw blades - points to
observed while hacksawing to
avoid breakage of hacksaw blades.

2	3	4	5
(11)			
ing letters & Nos. on M.S.	CHISELS & CHIPPING	7. Dihedral angles and for-	Common fraction to
Exercise on stamping to	Types of chisels - their material	mation of four quadrants.	decimal fraction & <i>vice</i>
judgement, control on	specification & application.		<i>versa</i> . Practical problems.
el. Stamping practice on	Hot chisels & Cold chisels.		
round surfaces.	Different cutting angles & their		
awing various metallic	importance.		
(Mild steel, Aluminium,	Method of chipping & safety pre-		
, Brass, Stainless Steel	cautions to be observed while chip-		
f different thickness &	ping. Use of proper hammer.		
sections, using hacksaw	Grinding - Sharpening of chisel		
of different TPI's within	on bench grinding machine.		
0.5 mm.			
rawing different lengths			
cksaw frame in Horizon-			
vertical positions.			
g along the parallel			
l lines within 0.5 mm			
nance for filing.			
rawing & Filing steps &			
t open fitting of finished			

2	3	4	5
ing, Flat, Cross cut & Round se chisels for chipping edges cutting grooves respectively. ipping edges & square to the es & edges. Checking with y square. itting of sheet metal with isel. rking geometrical profiles on et metal & filing to mark lines. arpening of marking tools. e of bench grinder for sharp- ng of scriber, centre punch, punch, divider etc. e of cross peen hammer for tching of metal strip.	DRILLS & DRILLING 8-10. Types of drills—Flat & Twist drills straight flated & special types. Parallel & Taper shank drills — construction/material & use. Nomenclature of Flat & Twist drill — specification of Drill, Drill an- gles & their importance, advan- tages & disadvantages of flat & twist drills. Drill grinding — sharpening of Drills, Web thinning—checking the ground drill, common faults—mis- takes & their ill-effects.	8-9. Orthographic Projec- tions.	

duction to drills. Prepara-
s for drilling. Marking out
position of holes & dot
ching. Deepening the points
centre punch. Checking for
re distance.

2	3	4	5
ing practice on Sensitive ing Machine using differ- types of drills & drill hold- devices. Safety to be ob- ed while working on drill- machine. ing, chain drilling & filing roduce square, round & tri- lar openings on 6 mm thick Preparing inserts & fitting ese openings.			

ing practice on varying
nesses & different materi-
ch as M.S., C.I., S.S., CU,
s, Nylon, Epoxy etc. Drill-
in Sheet Metal. Precautions
fety to be observed.
ter sinking, Counter bor-
& Spot facing operations
g bench drilling machine.
cises on Reaming with hand
ers & machine reamers.

10-11. Directional views 10-12. **POWER AND
(by Orthographic Projection ROOT**

Square root of a perfect
square by factor method.
Square root of any number
by division method. Prac-
tice Problems.

2	3	4	5
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ernal Threading by hand using Tap sets. External threading of split die and finishing of thread by die nut.

Marking centre of a round bar with the help of "V" block and scriber.

Drilling & Reaming of blind holes along the axis of round bars.

Grinding of drills to specifications & checking of angles with gauges. Grinding of Chisels.

Drilling to an accuracy of ± 0.1 mm, checking with an outside micrometer, Preparation of gauges for gauge fitting, Measurement of shaft & hole diameters using outside & inside micrometer.

Grinding round out of square bar to ± 0.1 mm.

DRILLING MACHINES

Introduction to drilling machine. Portable & hand drilling machine.

Types of drilling machines— Bench & Pillar — Upright type drilling machine.

Study of drill chuck, chuck key, drill drift, sockets & sleeves — construction, material & use.

2	3	4	5
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Method of drives, sizes, capacity & specification of a drilling machine. Special features, care & maintenance of drilling machine. Speed changing system, use of simple gear boxes, feed for drilling, standard Speed & Feed for various material, various methods for job holding on drilling machine tables.

Grinding on filing — Radius & circular filing using templates & gauges.

Using Templates & Gauges for checking Lathe tool angles. Checking of various angles & clearances of Lathe tools on square blocks. Checking with templates gauge already prepared.

REAMERS & REAMING

Introduction to Reamers, types of reamers, pitch of flute, precautions to be observed while reaming. Allowances for reaming, coolant used while reaming. Floating holders for reamers.

Construction & use of Hand reamers, expansion reamers, adjustable reamers, taper reamers, rose reamers, chucking reamers etc.

12-13. First angle method of Projection.

2	3	4	5
of Combination & Round Pliers to make different es/profiles by bending wire attach the blue print to de- o manipulative skills, hand ol & eye judgement. riveting, Marking out lo- n of holes for riveting. Use lly & snap for forming rivet s. Lap & Butt joint by cold ng.	SCREW THREADS Elements & forms of screw threads Single & multistart threads, Right & Left hand threads.		13-24. LOGARITHMS Laws of Indices. Finding Characteristic. Finding out mantissa. To get Logarithms of number by using log table. Addition & subtraction of logarithms. Multiplication & Division of Logarithms. Application of logarithms to multiplication & Division. Application of logarithms to power & roots. Practice problems.

Use on step & angular fitting.	Internal Screw Threading Hand & machine taps, sizes, tapping drill size, tapping on different types of materials, Lubricants for Tapping - tapping blind holes. Reasons for breakage of taps & removal of broken taps. Tap wrenches, construction, stand-	14-15. Third angle method of Projection.
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2	3	4	5
	ard dimensions. Determination of sizes of drill for tapping standard holes.		
e project work. Making el clamp, "C" clamp or meter standby using ac- l skills.	EXTERNAL SCREW THREADING Types of Dies, Solid & split dies, Die stocks & handles, Methods of thread cutting with die & die stock. Use of lubricants, setting the threading die. Use of hand chasers & machine chasers.		
ANCESD BENCH KING SKILLS ing on flat surface. Taking sion for high spots using an blue. Sharpening of ars using diamond wheel ping stone.	LIMIT FIT & TOLERANCE 16-18. Elements of Interchangeable system. Definition of limit, Tolerance & Allowance. Basic dimensions or sizes. How limit & Tolerance is denoted? System of Tolerances & Limits. ISI System. BIS system.	16-18. Practice on first angle & Third angle Projection method with only Vertical and Horizontal surfaces.	

2	3	4	5
	Examples of fixing limits for various types of Fits commonly met within in machine. Component Assembly such as Free Fit, Med. Fit, Snug fit, Wringing fit, Tight fit, Medium fit, Medium force fit, shrinkage fit etc. Interchangeability & Standardisation, method of selective assembly, Hole & Shaft basis of system.		

3 & fitting practice within - 0.04 mm on thick plates.
tail fitting, Hexagonal fitting of 40 mm, size cube
mm size square hole on 10 mm plate within tolerance or - 0.05 mm. Six way
Fitting exercises with re-ble fitting.

17-24. **METALLURGY**
Introduction to Metallurgy
Common terms used in Metallurgy. Iron ores, extraction of Pig Iron. Extraction properties of Cast iron. Varieties of Cast Iron.

2	3	4	5
Flats on cylindrical parts. square at the end & in the of cylindrical rod within 0.04 mm.	PRECISION MEASURING INSTRUMENTS Vernier Bevel Protractor Micrometer - inside & outside - constructional features, principle of operation, graduations, reading - use, care & maintenance. Depth, gauge, Screw thread gauge, Construction, use, care & maintenance.	19-21. Practice on single slant surfaces and double slant surfaces as per Orthographic Projection method.	

action to lapping process.
Lapping pastes, procedure for charging lap. Use of ne in lapping. Lapping on d cylindrical (internal & ul) surfaces.

ICATION OF AD- ED BENCH WORK- KILLS

GENERATION OF FLAT SUR- FACE

Scraping - Importance of Scraping
ing - Advantages - Different methods of scraping-scraping pro-

(20)

2	3	4	5
h have certain functional ionship to other parts such am motion driving mecha- dovetail by assembling using bolts, dowel pins ing devices etc.	cedure for producing flat surface. Checking of scrapped surface - Use of spirit level. Tools required for scraping. Scrapers - different types & their correct use - application - use of Surface plate, Straight edge, An- gle Plate, Master cylinder in the process of scraping.		
	MAINTENANCE HAND TOOLS	22. Lettering practice verti- cal style as per ISI.	
	Types of spanners - their material & uses - Box, Socket, Tubular, Hook spanner etc. Wrenches - material & use of T Socket. Monkey. Ratchet, Pipe wrenches etc. Types of screw Drivers - material & uses. Types of pliers - material & uses. Combination Plier. Long Nose Plier, Flat Nose Plier. Circlip pliers etc.		

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2	3	4	5
ion fitting jobs involving s, scraping & alignment.	FASTENERS AND LOCKING DEVICES Permanent, Semi-permanent and temporary fastening devices, Locking devices. Fasteners & Locking devices of different types - Belts, Nuts-Lock Nut/Check Nut/Castle Nut/Slotted nut/Serrated nut etc. & their func- tions. Screws-Machine screw, Philip head screw, Sheet metal screw, Wood screws etc. & their functions. Washers, Locking plates, Spring washers, Fibre washer, Tab washer, Rivets, Studs, Pins, Split pins, Quarter pins, keys etc. Mer- its & demerits with examples, ad- vantages & disadvantages of us- ing each one - where generally used and why ?	23. Lettering practice in- clines style as per ISI.	

24. Freehand sketching of
files, chisels, ball-peen &

2	3	4	5
		cross peen and sledge hammers.	
	RIVETS AND RIVETING The object of riveting, the relation between the sizes of rivets and thickness of the sheets, pitch of the rivets.	25. Freehand sketching of Hack saw frames, Center punch, Dot punch etc.	25-26. REVISION & TEST.
sion & Test.	26. TEST	26. TEST	25-26. REVISION & TEST
MAINTENANCE TOOLS g hand tools such as screw drivers, single and double end wrenches, single and double end spanners, box nut spanners, set spanners, circlip pliers, ches, pullers, extractors, Correct method to be used e to be taken in using these	ENGINEERING MATERIALS Properties & uses of Ferrous & Non-ferrous metals & their alloys such as Cast Iron, Wrought Iron, Mild steel, Carbon steel. Tool steel, High speed steel, Aluminium, Copper, Tin, Lead, Zinc, Brass, Bronze, White metal, Rubber & Plastic. Methods of producing cast iron steel. Study of physical, chemical &	27. Practice on oblique surfaces.	27-32. Metallurgy ...II Properties & use of Wrought Iron. Manufacturing of steel. Classification & application of steel. Revision.
			27-28. PERCENTAGE

2	3	4	5
	Mechanical properties of materials & testing of materials. Plastic deformation of materials—Cold & Hot Bending—Bending of strips. Change in Mechanical properties of material in Hot & Cold Bending. Meaning of Tenacity, Elasticity, Malleability, Ductility, Toughness etc. with special reference to practical application – use of various Engineering materials.		
ing out key ways of various shapes. Using cross cut for cutting keyways. Us- amond point chisel for corners. Checking depth eph gauge & fitting keys ways. g different types of keys		28. Practice on curved surface.	

(24)

2	3	4	5
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keyways on pulleys, gears etc.
hand.

ILLS INVOLVED IN ME- ANICAL HANDLING/ TRANSPORTATION OF ACHINE

pes, Slings and Chains
ifications and use of differ-
types of Ropes such as Hemp
ila nylon wire etc.
cticing different types knots
its application.
hod of joining two ropes to-
ier for extension.
ection of unsafe/defective
fitions of ropes & knots.
ifications & correct use of
gs.

29. Practice on positive and
negative cylinders.
29-30. RATIO AND PRO-
PORTION
Meaning. Practice Prob-
lems.

ING TACKLES

es and use of different types

30. Practice on cylindrical
and conical objects.

(25)

2	3	4	5
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ting tackles both mechani-
id hydraulic such as - screw
, chain pulley block, crabs
inches, rollers & bars, le-
lashings and packings.
of inclines plane, Hydrau-
rolleys etc.
and maintenance of lifting
ments.

STS AND CRANES

of hoists and cranes for lift-
urpose.
tructional feature and work-
rinciples.
ods of lifting jobs of vari-
hapes, sizes and weights.
of appropriate length of
is.

ection of chain links.

34. BASIC ELECTRICAL Dimensioning technique & 31. UNIT SYSTEMS
TECHNOLOGY systems in dimensioning. Different systems of units

(26)

2	3	4	5
	Modern theory of atomic structure in general—Nucleus, orbits & free electrons, orbital electrons, valence electrons free electrons. Classification of materials as conductors and insulators, semi-conductors & registers. Concept of electro-motive force, voltage, current and resistance. Ohm's Law and Kirchhoff's voltage and current law. Types of circuits—series, parallel and series—parallel.		for measurement of various quantities.

IC ELECTRICAL TECHNOLOGY

precautions applicable to electrical trade.

ing of wire & cables, colouring used on them. Re-insulation of wires/cables & soldering free ends of

Electrical work, power and energy – definitions and units of measurement and their inter-relationship. Primary sources of electro-motive force/electrical energy. Primary & secondary cells. Introduction to electrical supply

32-33. General practical rules in dimensioning. Lines & Angles, Parallel and Straight lines, Triangles – Types, simple-properties, Practice problems.

32-33. GEOMETRY

33-42. ALLOY STEEL

(27)

2	3	4	5
strands. Joining of flexible by soldering staggered joints in case of twin wires licare cables. Variation with difference of plugs, sockets, switches, & fuse holders, cutouts etc. their specifications & applications. Use of switches, push button limit switches, micro-switches by using continuity for their operation. Identification of live, neutral and bare wires before connecting wires to plugs, sockets, switches, cutouts etc.	system with special reference to AC. Different voltages in use—AC & DC. Effects of electric current in general.		Importance of alloy steel. Properties & application of alloy steel such as Nickel steel, vanadium steel, Manganese steel, Silicon steel.
Test lamp and multimeter identifying single phase/three power supply. Use of multimeter for voltage,			

(28)

5

4

3

2

ent and resistance measure-
: Checking of DC supply.
of Volt Meter and Ammeter
voltage and current meas-
ents respectively. Connect-
portable single phase AC
ited industrial equipments
as drilling machine and
estic applications such as
ing machines, cooking
; geyser etc.
ice of series & parallel con-
on of loads & measurement
ltage drops across the leads
e current.
ice of logic development
ontrol. Constructing logic
circuits such as AND, OR,
etc. by using series & par-
combinations of switches
ontrol the condition of lamp
(ON or OFF) - condition

(29)

2

3

4

5

out lamp indicating output
ions in truth table.
g of simple electrical cir-
to understand the concept
trol) on test boards such
gle points series parallel,
; staircase godown, con-
lamps. Wiring & testing
escent lamp fitting. Func-
f choke & starter in its
ion.
& Maintenance of batter-
harging of batteries. Se-
parallel connection of
es.

ELECTRONICS

of industrial electronics
ference to its application
hine tool operation.
ication of basic compo-
such as Resistor, Capac-
nductors etc. from their

34-36. Practice on
dimensioning.

2	3	4	5
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look. Types, specifications general applications of these components. Testing & measurement of their values using timer. Use of Resistance four codes. Soldering and soldering of component on from printed circuit boards 3) Precautions to be taken e soldering on PCB.

y of Rectifiers available in rent packages – Lead identification and testing by meter.

of Rectifier circuits – half s, full wave and bridge rectifiers. Use of Oscilloscope for checking of input and output forms.

of solid state devices such as diodes, Transistors, SCRS

ICs available in different ages. Types & Applications. Identification leads & testing by meter. Assembly of simple battery inductor circuit using bridge fier and filter capacitor. Measurement of input and output voltages.

ES & PIPE FITTING

liarisation with plastic deformation of material. Cold & ending of strips. ing of solid sections by bending fixtures, bending etc.

& hot bending of pipes of ent diameters of ferrous i.e., hydraulic pipes & non-as metal, i.e., copper tubes brication system.

bending with or without r in fine sand.

35-36. BASIC ELECTRONICS

Semiconductor theory.

Intrinsic & extrinsic semi-conductors.

P & N type semiconductors & P-N junction – a Semiconductor Diode – two layer and two terminal device.

Use of a P-N junction as switch.

Use of P-N junction for rectification, Half wave, Full wave and bridge rectifiers.

P-N-P & N-P-N junction devices a transistor – three layer three ter-

36-37. CIRCLE

Definition, elements, simple properties. Internally & Externally touching circles. Figures inscribed in and described about circle. Practice problem.

of pipe bending fixture to maintain uniform bending radius. Precautions to avoid wrinkling, cutting using pipe cutter. Threading & piping using pipe fitting such as "T" fitting, Elbow fitting, reducers, punching of holes on leather, hollow punches. Preparation of gaskets & other packing materials. Fitting practice & ferrule fitting.

minimal devices. Use of transistor as a switch. Use of transistor for amplification - how amplification takes place. Soldering technique as applied to PCB soldering DO's and DON'Ts.

BASIC TRAINING IN INDUSTRIAL HYDRAULICS

Study of block diagram of hydraulic system in general. Instruction features, principles of operation, functions & uses.

37-40. BASIC TRAINING IN INDUSTRIAL HYDRAULICS

Industrial hydraulics—principles, advantages, disadvantages & safety. Study of block diagram of hydraulic system in general ferrous metal *i.e.*, copper tubes for lubrication system.

37-38. Freehand sketching & 38-39. GRAPHS of Maintenance tools like Simple Graphs—Functions. spanners—single/double end & ring circlips, Pliers—roundness, Combination, Circlip etc.

various hydraulic components as Pumps, Valves, Actuators and Power pack. Hydraulic fluids—specifications, properties and applications. Use of hydraulic power pack control elements. Familiarisation with various tools used in hydraulic circuit diagram. Identification of components, their out look and their functions. Hydraulic circuit reading & tracing practice. Drawing practice using tools. Constructing simple hydraulic circuit for linear/rotary motions for operation. Constructing simple hydraulic circuit for speed control both linear/rotational and testing for function.

Pipe bending with or without filling in fine sand. Use of pipe bending fixture to maintain uniform bending radius. Precaution to avoid wrinkles. Pipe cutting using pipe cutter. Pipe threading & piping using various pipe fitting, Elbow fitting, reducers etc. Punching of holes on leather with hollow punches. Preparation of gaskets & other packing materials. Standard pipe threads, cutting of pipe threads using dies & taps. Methods of protecting leaks at the joints. Care & precautions to be observed, while using pipe vice, pipe wrenches, dies & taps. Standard pipe fittings—methods of fitting & replacing the fittings. House hold piping—standard pipe fittings. Fullering practice & ferrule fitting.

TRAINING IN PNEUMATICS

struction features, principles of operation, function & uses of pneumatic components such as solenoids and actuators. Identification of components and their out look and their applications. Pneumatic circuit reading (from symbols) and circuit tracing. Practice in drawing practice using symbols for simple application. Constructing simple pneumatic circuits for linear reciprocating and rotary motion. Testing of solenoid motion. Testing of solenoid motion.

TRAINING

Instructional features and training principles of lathe machine. Relationship of vari-

PREVENTIVE MAINTENANCE

Importance of Preventive Maintenance in modern Industry. Functions involved in Preventive

41. Drawing of simple circuit diagrams in Hydraulic and Pneumatic. 42. Drawing of piping lay-

40. Basic symbols of Hydraulic and Pneumatic

Angle measurement system. Trigonometrical ratios. Trigonometrical identities. Practice problems. Expressing all Trigonometrical ratios in terms every ratio. Practice problems. Trigonometrical ratios of various angles (Angles in degrees 0, 35, 45, 60, 90), practice problems. Simple application to Shop problems. Practice problems.

parts of the machine. of the gear box and drives in the machine. of the methods of holding piece & tool using different vices. on plain, stepped, taper turning, knurling etc. on drilling, reaming, counter boring etc. thread cutting both external and internal of different on eccentric turning. of Lathe tools. and maintenance of machine.

precautions to be observed while handling machines. of lubrication system and preventive maintenance. projects such as hollow pulleys, gear blanks, simulating etc.

maintenance. Advantage of Preventive maintenance. Frequency of preventive maintenance - preparing Preventive maintenance schedule-points to be considered. Lubrication survey-system of symbols and colour coding.

LUBRICANTS AND LUBRICATION

Friction-its effect, methods of reducing friction. Use of lubricants, use of bearings. Lubrication-need & use, How it is done.

Qualities of a good Lubricant - Viscosity of the Lubricant - Main properties of Lubricant. How a film of oil is formed in Journal Bearing. Methods of Lubrication - By gravity feed, Forced feed, Solash lubrication.

43. Introduction to sections and sectional views. 44. Different types of sections used in Engineering drawing. 45. Conventions used in sectioning.

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Lubrication grooves & Ring lubrication.

Effect of thick & thin lubricant.

Lubrication for high & slow speed drives.

Common lubricating oils and greases, their specifications and commercial names.

Selection of Lubricant.

BASIC MACHINE WORKING SKILLS

Metal cutting and cutting tools.

Introduction to metal cutting.

Mechanism of metal cutting-orthogonal and oblique cutting, chip formation types of chips and chip breakers.

Cutting tool geometry and nomenclature, control of angles, tool life.

Cutting speed and feed.

CUTTING FLUIDS AND COOLANTS

Properties and uses - cooling, system types - soluble oils - soaps,

43-50. SPECIAL ALLOY STEEL

Importance of special alloy steels. Properties & uses of alloy steels such as Magnet steel, Heat resisting steel. Such resisting steel etc. Properties & application of High speed steel, Stainless steel & Cemented Carbides.

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sudsparaffin, soda water etc.

Effect of cutting fluids in metal cutting.

DING

unctional features and g principles of surface

lindrical grinding ma-

onal relationship of vari-
ts of the machine.

of drive-both mechanical
draulic.

of different work holding

ig wheel specifications.
ng, balancing, truing &
g of grinding wheel.

es on surface grinding-
angular, step and groove

g.

es on external & internal
ical grinding-both plain

STUDY OF LATHE MACHINE

Construnctional features, types, tion.

functions & use of Lathe machine. 47-48. Types of lines used

Study of Lathe accessories - Face in engineering drawing & plate. Chucks, steadies their use. application of these lines on

Driving mechanism - Gear box drawings.

mechanism - gearing. Common

Lathe tools - their names, materi-

als & use, cutting tool angles,

grinding of lathe tools.

Common Lathe operations -

chucking, centering, plain turning,

facing & boring, taper turning -

taper calculations - screw cutting.

Cutting speed and feed, use of

coolants.

Care and maintenance - preven-

tive maintenance.

46. Introduction to full sec-

multiple tool & cutter grinding practice.
 Use of hydraulic system used in the machine.
 Care & maintenance of machine.
 Safety precautions to be observed while using machine.
 Use of lubricating system and preventive maintenance.

SHAPING

Instructional features & work-principles.
 Functional relationship of various parts of the machine.
 Use of Quick Return Mechanism.
 Different work & tool heading / uses.
 Flat & angular shaping.
 Profile cutting on shaping machine.
 Grinding of shaping tools.
 Care and maintenance of machine.

GRINDING MACHINES

49-50. Practice of Uniform Constructional features, types, thickness lines by using functions use of Grinding machines.

Grinding wheels and their satisfactions - Grit, Grain, Size, structure, Bend, Grades etc.
 Use of grinding wheels, balancing and truing. Dressing of grinding wheels, holding of work piece.
 Various grinding operations - external, internal, surface of grinding.
 Selection of speeds & feeds in

Precautions in handling grinding.

Common defects - faults their detection and rectification.
 Use of coolants for grinding different materials.
 Safety precautions to be observed in grinding operations.
 Care and maintenance - preventive maintenance of grinding machines.

PAINTING

Use of painting/protective coating for rust prevention.
 Surface preparation, use of primers & surfacers.
 Spray painting - paint-metallic & wooden articles.
 Finishing practice.

51. Practice of uniform lines by using compass. 51-52. REVISION & TEST

51. TIMBER & RUBBER

SHAPING

52. TEST

52. REVISION & TEST

GRINDING

53-54. SHAPING MACHINE

Constructional features, function and Tolerances & their applications. 53-54. Uses of Limit, Fit and Tolerances & their applications. 52. REVISION & TEST

ing principles.
tional relationship of vari-
arts of the machines.
of gear-box & drive used
e machine.
ises on parallel & angular
ig.
ises on grooving using &
ing of gears-spur & heli-
sing simple indexing.
of slotting attachment for
g key ways.
and maintenance of ma-
precautions in handling
ne.
of lubrication system and
tive maintenance.
e project such as jaw, claw,
n, coupling, spline cutting

and uses of shaping machine,
working principle – use of quick
return mechanism.
Setting of length & position of
stroke.
Holding of work piece and tools.
Various cutting tools & tool an-
gles for carrying out shaping op-
erations.
Speeds and feeds.
Use of coolant for different mate-
rials.
Detection of common faults &
their rectification.

Importance of Non-Ferrous
metals. Properties & uses
of copper, Aluminium &
their alloys such as Bronze,
Brass. Properties & uses of
Zinc, Lead. Bearing Metals
solders, Brazing spelters.

53-62. ALGEBRA

Simple equation with one
unknown. Simple equation
with two unknown. Prac-
tice problems. Simple quad-
ratic equations. Practice
problems. Simple expan-
sion. Practice problems.
Simple formulae. To frame
& solve simple equations.
Practice problems.

55-58. MILLING MACHINES

Constructional features and work-

55. Geometrical construc-
tions-Bisecting lines & an-

ing principles, types, functions, use
of milling machines, attachments
& accessories.
Different methods of holding work
piece & cutters.
Common milling operations such
as plain, step, angular milling, slot
& grove cutting, use of dividing
head for indexing – types.
Various types of gears & elements
of gears. Gear cutting, Cam cut-
ting.
Cutting speed and feed. Use of
coolant for different materials.
Detection of common faults – de-
fects & their rectifications.
Safety precautions.
Care & maintenance – preventive
maintenance of milling machines.

gles, to make equal divi-
sions of a straight line.
56-57. Geometrical con-
struction on Polygon & cir-
cles.

T METAL WORKING
e in drawing simple geo-
al shapes on sheet metal
marking tools.

SHEET METAL WORKING

Commonly used sheet metals –
rolled sheets such as Tin, Galva-
nised Iron, Copper, Brass & Alu-

58. Geometrical construc-
tion on inscribed circles in
Polygons.
59. Geometrical construc-

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actice in cutting sheet metal
se shapes & cutting sheets to
rious angles using hand shear,
p & chisel.
nding sheet metal to 90 de-
es using wooden mallet,
mp etc. on a bench.
actice on lap joint, lock
oved joints & hemming.
ting practice with different
s, cutting of notches, inside
outside curves.
et metal cutting on shearing
hine. Safety in operation.
ning rectangular, round &
cal shapes using stakes.
oval of dents & Simple hol-
ng practice.
of Hard & Soft Solder.
ering practice on ferrous &
ferrous metal.
ice in riveting sheet metals
rious thicknesses.
ise using pop rivets.

minium sheets – their physical
properties & uses.
Common tools used for sheet
metal—Tinman, mallets, stakes,
swages, shears, ships, strips,
scribers, trammel, dividers etc.
Simple developments and method
of laying out.

tion on described circles in
Polygons.

Types of joint—folded joint,
grooved seams, wired edges etc.
Allowances for Lap joints,
Grooves & Beads etc.

Soldering, sweating, Brazing &
Tinning materials & methods em-
ployed.

Soft & Hard solder – their compo-
sition, properties & use.

Fluxes and spelters – importance
and use.

Soldering iron-types and uses.

Preparing the job for soldering,
methods of soldering.

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le development work.
ice in making simple arti-
such as, machine guards,
als & trays, funnels, taper
etc.

cing principles of Arc, Gas
ot welding machines.

ecting & setting of ma-
as for operation.

y to be observed in weld-
work.

ice in simple arc welding
material of different thick-

zontal & Vertical Position
ling.

tice on Butt & Lap joints.

tice in Brazing of ferrous &
ferrous metals, silver braz-
braze welding (Dissimilar
als)

ly of welding defects (Arcs &
) & precautions to avoid

61-63. BASIC HOT WORKING SKILLS WELDING

Gas & Electric welding-tools &
equipments.

Principle of fusion welding.

Types of joints & method of weld-
ing.

Care & maintenance of
equipments.

Welding defects – causes & how
to avoid them.

Flame cutting – use of equipments
& principle involved.

60. Geometrical construc-
tion on tangential arcs &
circles.
61. Preparation of Tem-
plates by using tangential
arcs method.
62-63. Welding symbols as
per BIS. Blue print reading
of Fabrication drawings.

61-68. MEASUREMENT
Importance of measure-
ment. Necessity of Units
definition & requirement of
Unit. Fundamental of de-
rived units. Systems of
Units. Conversion of Units.

m.
 practice in metal deposition for
 filling of cracks, repairing of
 worn out parts, key ways, keys,
 broken gears, Gear teeth filling
 adding on shafts. Practice in
 re cutting. Care & mainte-
 nance of welding equipment.

FORGING

Introduction to forging tools and
 equipment. Use of hammers,
 sledge, set hammer, flatters,
 swages & swage blocks.
 Practice on upsetting, twisting,
 bending, punching, drilling &
 welding.
 Drawing of hot bars.
 Drawing an eye bolt out of a
 bar, Local heating &
 drawing the end to form spike.
 Drawing down of thicker sec-
 tion of fullers, anvil edges
 drawing to finish the surfaces.

Drawing of top & bottom swage.
 Drawing down & forming to
 uniform sections.
 Finishing & forging small
 work heads.
 Drawing common tools such as
 punch, chisels, screw driv-
 ing roller legs etc.
 Drawing maintenance of forging

TREATMENT

Introduction to various furnaces
 for drawing.
 Drawing and tempering of
 tools.
 Drawing of hardened compo-
 nents (jobs) & normalising.
 Drawing of common forged
 tools such as centre punch,
 screw drivers etc.
 Drawing hardening of shafts, pins,
 spacers, couplings, gears

64. FORGING

Types of forging-Hand Forging.
 Effect of head on Grain structure
 of material.
 Equipments used in forging-
 Sledge hammer, Set hammer, Flat-
 ters, fullers & Swages & Hardies.
 Main operations like upsetting,
 drawing down, twisting, bending,
 drifting & forge welding.
 Defects in forging.

64-65. Freehand sketching
 of different types of stakes,
 swage blocks and different
 types of tongs.

63-68. MENSURATION
 Area of simple figures,
 Practice problems. Volume
 of simple bodies. Practice
 problems. Estimation of
 material & cost of material
 practice problems.

e hardening of slides.

IC MAINTENANCE LS

liarisation with plain/journal bearings, anti-friction bearings on machine assembly. Ification & selection for appropriate use. Use of manufacturers catalogues. nting of bearing on shafts a housing with proper fit & alignment. Use of proper oval of bearings from shafts using by using pullers. nting up & removing old from bearings & replacement with new metal. Scrape & fit ngs to a shaft. Fitting shaft ain line bearings. Cut oil es in bearings. king of shafts for alignment dial indicator. Practice in ing flat bearing surface.

65-66. HEAT TREATMENT

Structure of material & Iron carbon equilibrium diagram.

Heat treatment on metals & alloys its necessity.

Definition, description & process employed for Hardening, Tempering, Annealing, Normalising, Case Hardening & Carburising.

Cyniding, Nitriding, Flame Hardening and Induction Hardening. Equipment—Furnaces, Tools used for Heat Treatment, their care and maintenance.

Importance of time & temperature elements in transformation.

Change in properties of material due to heat effect.

Temper colour chart.

66-68. Advanced exercises in First and Third angle Projection method.

RHAULING OF SIM- MACHINES & ACCES- ES

entailing simple machines such as machine vice, jaw chucks, index head, lock, slotting attachment, it pumps, using various tools with specific reference to functional part of their ne elements. ing & oiling of dismantled Assemble & Testing for tion. enting of simple machines is Bench Grinder, Pedestal er, Sensitive Drilling machines. Cleaning & oiling of & assembly & testing.

PRECISION MEASURING INSTRUMENTS AND GAUGES

Micrometers—special types—important features & applications e.g., Thread checking Micrometer. Flange Micrometer ? Depth Micrometer etc.

Sine Bar, Slip Gauges.

Types of Gauges—Plug, Ring, Snap, Taper, feeler, Screw pitch, Radius & sheet metal gauges.

Dial Indicators — construction & use. Various types.

Comparators—Electrical, Optical, Pneumatic—construction & working principles.

ELING

uction to levelling of machines. Practice on levelling —

SURFACE FINISHING PROCESSES

Definition of surface finish.

70-71. Types of Bearings e.g., Simple & Bushed bearing, Foot step bearing and

69-76. MOTION

Definition & types of Motion. Displacement & speed. Velocity & types of velocity. Acceleration. Problems on speed. Velocity & Acceleration. Equation of Motion. Problems on Equations of Motion.

69-71. TRIGONOMETRY

Application of taper calculations. Application to coordinate & Chordal center distance. Practice problems.

of spirit level, camel back, right edge, bridge, parallel bars etc.
 Dressing of surface plates, grinding table, milling machine, grinding machine etc. preparation of test report indicating degree of flatness—Use of leveling bolts, taper wedges for leveling of horizontal and vertical surfaces.

Terms used to describe the surface finish. Plummer block.

Dimensional tolerance of surface finish.
 Surface quality & its symbolic representation.
 Equipments used for testing/measuring surface quality.
 Units of surface finish.
 Surface finishing processes.
 Lapping, Electroplating, Metal spraying, Galvanising, Pickling & Metallisation.

CHINE ALIGNMENTS

Introduction to machine alignment.
 Use of test mandrel, master cylinder, straight edge centerators, special fixtures, slip gauges and indicators for machine alignment.
 Grinding lathe, milling, grinding machines for alignment &

LAPPING

Definition of Lapping & its necessity. Constructional features of Lapping.
 Design of Laps—Cast Iron, Copper, Lead, Mild steel etc.
 Abrasive material & the form in which it is applied.
 Popular names of abrasive used.
 Simple examples, practical situations of Lapping.

72-73. Type of Threads (Vee and Square) Conventions in threads.

72-76. CUTTING, TURNING, DRILLING & BORING CALCULATIONS

Cutting Speed-definition, formula, calculation to find out RPM of cutter/job. Cutting Feed-Longitudinal & Cross. Rate of material removal. Estimation of machining time. Practice

Preparing test reports comparing with standard test charts.

tions of Lapping.
 Lapping methods & their applications.

problems.

Testing of surface quality after Lapping.
 The objective of Honing—description of honing & its necessity—honing methods & their use. Simple examples, situations where honing is used.

Rotary & Longitudinal motion in Honing Cylindrical object. The effect of Honing on the efficiency of running components.
 Honing tools—Shape of abrasive—Grades.

Honing allowance.

PRINCIPLES OF PREVENTIVE MAINTENANCE

Study of various machine tools such as Lathe, Milling, Grinding & Shaping machines with special attention to transmission

75-77. BEARINGS

Method of reducing friction, use of Bearings.
 Bearings—different types for high speed & low speed—their applications.

74-75. Construction of Engineering curves (Ellipse by different methods.)

mechanism. Study of machine accessories, their function & operation.
Introduction to magnetic clamping devices such as magnetic chucks, lifting magnet-working principles, testing & safety aspects in handling/using such devices.

Materials for the bearings and their properties.

76-77. TRANSMISSION OF DRIVES

Study of Belt pulley, chain, Gear, Rack & Pinion etc. used on different machines.
Introduction to various gear transmission mechanisms.
Removing gear box from various machines & opening for inspection & study of gear trains & their functional relationship.

Specification of Bearings

Dimensional relationship of the shaft with bearing—the type of leads. Methods of clamping & fitting the bearing in the housing.
Methods of mounting & dismounting.
Essentials of ordinary type Brass Bearings—process of fitting.
High Speed & loaded bearings—use of Ball & Roller bearings—constructional features of Ball & Roller bearing & housings.
Method of fitting ball & roller bearings on the shafts.

76. Construction of Involutes. 77-78. REVISION & TEST
77. Construction of Cycloidal curves Cycloid Epi and Hypo Cycloid. 77-78. REVISION & TEST

Commercial specifications of Ball & Roller bearings.

Anti-friction bearings—their types & uses.

Lubrication of bearing—High speed bearing.

Care & maintenance & inspection of bearing.

78. REVISION & TEST.

78. TEST

79-80. TRANSMISSION OF DRIVES (contd.)

Dismantling of gear box completely. Study of various machine elements from the gear box. Cleaning & checking/inspection of parts for damage/repairs.
Assembly of gear box & fitting back to the machine.
Testing of operation.
Preparation of report.

79. GENERAL SAFETY

Safety rules to be practices on shop floor.

General safety rules & practices in workshop.

Safe working habits & safety consciousness.

Safe working devices, guards, attachments etc.

First aid practices.

Fire fighting equipments & practice.

78. TEST

79. Construction of Archimedean spiral.

79-84. NEWTON'S LAW OF MOTION

Laws of Motion, Definition, Units, Types. Difference between Mass & Weight. Problems on Laws of Motion.

79-90. Screw & Screw Cutting calculations

Various Thread forms. Pitch, T.P.I. Conversion of English pitch to Metric pitch & vice-versa. Lead, Helix angle. Apparent & True cutting length. Screw

thread cutting on Lathe.
Simple & Compound gear
trains. Cutting English
threads on Metric Lathes &
vice-versa. Practice prob-
lems.

81.-84. SPINDLE ELEMENTS

Study of various spindle drive
mechanism used on bench
grinder, drilling, milling, lathe
& grinding machines.
Checking for spindle runout-
axial & radial play. Setting of
play as per standard chart.
Checking of bearings for its per-
formance-repairs & replace-
ment as needed.

80-81. PREVENTIVE MAINTENANCE

Introduction to maintenance work.
Importance of maintenance.
Methods & tools of maintenance.
Basic concepts of routine & pre-
ventive maintenance.
Importance of preventive main-
tenance.

Inspection, diagnosing & repair-
ing procedure.

Scheduling & planning for pre-
ventive maintenance work.

Maintenance of records, Log cards
etc.

80. Construction of Helix.
81. Introduction to various
types of sections such as
Half section, Broken sec-
tion. Revolved Section, re-
moved section & aligned
section.

82-83. OVERHAULING OF MACHINE

Planning for schedules over-
tion.

82. Practice on Half & bro-
ken Section.

83. Practice on Off-set sec-
tion.

hauling.

Precautions to be while dismantal-
ing
Sequence of operations of
marking of parts.

Methods of cleaning materials
their names & specifications.

Proper method of removal & fit-
ting of bearings.

Re-assembly of machine in cor-
rect sequence & testing for cor-
rect functioning.

84-88. MECHANICAL HANDLING & TRANSPORTATION OF MACHINES & EQUIPMENTS

Different types of appliances &
tackles for shifting, loading and
unloading of machines &
equipments.

Screw jacks-their use & working
principles.

Chain Pulley blocks-their use &
working principles.

Crane & Hoist for lifting purposes-

84. Practice on removed &
revolved sections.

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working principles & main constructional features.

Working principles & use of other tackles like Crabs, Winches, Slings, rollers & bars, levers, lashings and packings.

Mechanical advantage & Velocity.

Use of inclined planes.

Special precautions in handling heavy equipment, removal & replacement of heavy parts.

Safety in transportation.

85-86. **Template & Gauge making**

Revision of bench skills—form matching.

Preparation of templates made of ferrous & non-ferrous materials.

Inspection of templates on shadowgraph.

Preparation of gauges & templates using master paste, lead, plaster of paris etc.

85. Practice on aligned section.

86. Conventional representation in sectioning *i.e.*, Ribs, Webs, Hatching lines, Dimensioning in sections, Conventional breaks etc.

85-88. **WORK**

Definition & Units of Work. Positive work, Negative Work, Work done with constant force & Variable force. Graphical representation of work. Problem on work.

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Matching of profiles on thin materials.

87-89. **APPLICATION OF MACHINE SKILLS**

Application of machine working & not working skills.

Fabrication of special fixtures, equipment required. Machine maintenance—trolley for carrying dismantled parts or machine elements.

Manufacturing of screw jack, pipe bending fixture, "C" Clamps, pullers, extractors etc.

87. Introduction to primary, Auxiliary Projection.

88. Practice on Primary, Auxiliary Projection.

89-91. **CNC MACHINES**

Introduction to CNC machines
Difference between NC, CNC, & GPM.

Importance of CNC machine over other mass production processes.

89-92. **POWER**

Definition & units of Power. Brake Horse Power & Indicated Horse Power. Problems on power.

89. Introduction to Secondary Auxiliary projection.

Constructional details & working principles of CNC machines—

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machine beds—Ball Screw mechanism—Serve Drives—Feedback Mechanism etc.

90-93. **CNC MACHINES**
Introduction to CNC Technology.
Special constructional & operational features with reference to driving mechanism, machine tool design, lubrication systems. Familiarisation with Co-ordinate system, use of CNC Codes. & programming practice.
Manufacturing of simple job on CNC Trainer after programming.
Care & maintenance of CNC machines.

CNC tooling and fixtures.
Manual part programming.

90. Practice on Secondary Auxiliary Projection.
91. Concept of co-ordinate axes in CNC.
92. Preparation & reading of component drawing for CNC.
93. Axes designation (X, Y, Z, A, B, C & U, V, W) Application of Co-ordinate Axes in CNC.
91-102. **MECHANICAL PROPERTIES**
Stress, types of different stresses, types of different Ultimate stress of strength of material. Efficiency of joint. Practice problems.
Work, power, efficiency—Calculations torque. Estimation of cost for consumption of power. Practice problems. Transmission of motors—Belt transmission, Gear transmission. Practice problems.

94-96. **ADVANCED ELECTRICAL TECHNOLOGY**
Familiarisation with electrical symbols being used in electrical

92-95. **ADVANCED ELECTRICAL**
CAL
Electro magnetism.
Concept of a coil (electromagnetic)

94-95. Basic Electrical & Electronic symbols.
96. Theory of Isometric Projection.
93-96. **ENERGY**
Definition, Units & types of Energy, Kinetic Energy, Energy of body under grav-

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circuit diagrams.
Practice in rearing electrical circuit/connection diagrams from the instructions manual. Circuit tracing practice. Identifying electrical hardware items from their outlook.
Checking/testing of relays, auxiliary contractors, power contractors by connecting appropriate power supply.
Checking of contact operation (opening & closing) of relays & contactors.
Practice on logic development for control using relays & contactors.
Developing control circuit using ladder/schematic diagram.
Use of control elements to build & test manual, inching, hold on & start/stop push button control circuits.
Circuit building practice. Wiring

netic) & Capacitors—principles of operations.
Use of a coil in Hydraulic & Pneumatic solenoids.
Use of Capacitors to store energy
Electromagnetic induction.
Motor effect & generator effect.
Electrical motors—construction & features, types of both AC & DC motors and applications.
Measurements of Electrical quantities—use of Volt meter, Ammeter & Multimeter—Principle of operation.
Elements of electrical system—control, power & safety elements.
Automatic operation—use of control circuits—logical development of control circuit diagram using contactors and relays.
Concept of ladder diagram.
Understanding of power & control circuit in general (with few examples) Inter-relation between

ity. Problem on Energy.
Principle of conservation of Energy.

ing of power & control circuit them.
on test board such as direct on line starter, automatic star-delta starter & forward/reverse Control for 3 dia. Induction motors etc.

Study & use of safety elements such as miniature circuit breaker (MCB), overload relay, earth leakage relay, protecting fuses in power circuit wiring & testing.

Measurement of winding & body resistance of DC motors & induction motors by multimeter. Connecting induction motor to panel & measurement of line current.

Simulated fault finding on control panel.

Isolation of machines from electrical cabinet by removing back up fuses switching off mains switch.

Safety in handling & operating electrical equipments.

96-97. ADVANCED ELECTRONICS

Introduction to Logic gates *e.g.*, AND, OR, INVERTER, NAND, OR, EX-OR etc.

Their truth table, analogy of logic gates, combination of Series & Parallel switches.

Introduction to commonly used Transducers in Industries *e.g.*, Thermocouples, LDRs, Thermistors, LV DT, Strain Gauge, Magnetic pick-up, Photo-diodes, Photo-Transistors etc.

Introduction to commonly used controls in industries such as Timers of different types. Counters, Proximity switches (AC, DC), Over current relays, DC Motors controllers, Photo-electric relay, Temperature controller.

Removing electrical motors from machine tools. Terminal marking procedure before disconnection of wires from terminals/brushes.

Replacement of brushes, setting of brushes.

Locating overloaded motor & finding out its causes such as fuse blown, mechanical jamming, loose connections, faulty settings etc.

Locating faults in power circuit such as power fuse blown, MCB tripped, control fuses blown etc. Checking of electrical motors by measuring winding resistance, balance of resistance, body resistance.

Checking of electro-magnetic clutches, brakes, chuck magnets etc.

Concept of programmable logic controllers—its fundamental blocks—Input, Output, Memory, Power Supply, Comparison of PLC with conventional machine control. Programme development terminal. Function of various on

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97. ADVANCED ELECTRONICS

Introduction to logic gates & their truth tables. Building logic gates such as AND, OR NOR, INVERTER, NAND, EX-OR using Diodes & transistors output lamps indicating conditions in truth table (Analogy of logic gates to series & parallel combination of switches).

Study of commonly used Transducers—such as thermocouples, LDRs, thermistors, LVDTs Strain gauges, magnetic pick up photo diodes, photo transistors etc.

Familiarisation with commonly used controls in our industry such as Timer, Counter, Proximity switches (DC & AC), over current relay, DC motor controllers, photo electric relays, temperature controls. Demonstration of each controlling unit.

Introduction to programmable

97. Preparation of Isometric scale. Angles, Arcs & Circles in Isometric.

97-102. STRENGTH OF MATERIAL
Stress—definition & units. Types of stresses. Strain & its types. Elasticity, Hook's Law & Modulus of Elasticity. Behaviour of Mild steel under tensile load. Factor of safety. Problems on Stress, Strain, Elasticity & Factor of Safety. Practical applications.

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logic controller (PLC—only concept). Its fundamentals blocks such as input, Output, Memory, Power supply etc.

Comparison of PLC with conventional machine control (appreciation only).

98-101. ADVANCED HYDRAULICS

Circuit building practice—regenerative (Sequencing) circuit with speed & pressure (Clamping) control. Counter balance circuits with speed control Traverse & feed circuits. Differential control circuits. Circuits using pilot controlled check valve, pressure regulator valve, pressure relief valve etc.

Study of machine tool applications of the hydraulic drives for Rotary, Reciprocating, speed changing, clamping, unclamping & feed motions.

98-101. ADVANCED HYDRAULICS
Constructional features, working principles & uses of pumps, Positive & non positive displacement of pumps, Gear Pump, Vane Pump, Piston Pump, Axial Piston & Radial Piston Pumps.

Constructional features & working principles of valves, Types of Valves—Directional Control, Pressure Control, Flow control. Direction control Valve according to their spool position e.g., 3/4 DC, 2/3 DC—types of spools. Check Valves, Types of Check

98. Construction of sphere and Irregular Curves in Isometric.
99-100. Exercises on Isometric drawings.
101-102. Freehand sketching of outside Micrometer, Vernier Caliper, Inside & Outside Spring Caliper.

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Trouble shooting in hydraulic drive circuits for low pressure, noisy system reduced speed of the table traverse, jerky traverse of machine table, jamming of piston rod at the end of the stroke pressure increase in the system etc.

Repairs & maintenance of pumps-gear, vane & radial pistons.

Repairs & maintenance of valves-pressure control, direction control & flow control. Adjustment of valves.

Repairs & maintenance of actuators-single & double acting cylinders, Hydraulic motors etc.

Piping practice with metallic & hose pipes.

Use of Various types of pipe joints and fittings.

Precautions to be taken in storage & handling of oils.

valves-application-construction & uses, pilot operator check valves. Servo Valves, Block diagram of servo valve, Mechanical servo, Electrical servo, Single stage spool servo, Flapper type servo & Jet type servo.

Pressure Control valve-constructional features & working principles of simple relief valve-compound relief valve-"R" type relief valve-"R" type unloading valve-"R" type sequence valves-other types.

Flow control valves-constructional features & working principles of Flow control valves & their uses.

Meter-in circuit, Meter-out circuit, Bleeding-off circuits.

Compensating features, pressure, temperature & Flow.

Actuators-constructional features & principles of Hydraulic actuator.

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Study of pressure gauge, pressure selectors & filter units.

Setting of various hydraulic elements for proper functioning.

Repairs of hydraulic presses & various hydraulically operated equipments.

Fault finding by simulation.

Hydraulic motor-Rotary actuators, Hydraulic cylinders-types & their applications in hydraulic circuits, specifications-Cylinder.

Pipes & pipe work-types & selection-specification, material, bending of pipes, pipe bending fixtures & pipe bending methods.

Standard fittings of pipes *e.g.*, Ferrules, Procedure for connecting pipe fitting work, installation of pipe, pipe storage.

Flexible hoses-types & their specifications used according to the pressure in the line, correct installation of flexible hoses & its importance.

Constructional details, specification & uses of Tank/reservoir, heat exchanger, heater, Filter/Strainer, pressure gauge, Intensifier, Accumulators.

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102-103. ADVANCED PNEUMATICS	102-103. ADVANCED PNEUMATICS	103. REVISION.	103-104. REVISION & TEST
Circuit building practice—use of shuttle valves for control, circuit for speed regulation of single & double acting cylinders, time dependent control circuits etc.	MATICS Constructional details, specifications, application of power unit, actuating unit, control unit. Power unit-types of compressors—Reservoirs, condensers, Filters, Service units. Actuating units—single/double acting cylinders, rotary actuators, Sander, Disc, grinder, Nut runner etc. Control units—directional control, Pressure control & Flow control valves. Pipes & pipe fitting—materials, types, specifications & applications. Types of Seals, Packings & Glands.		

104. REVISION & TEST.

104. TEST

104. TEST

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105-107. SHAFTS AND COUPLINGS	105-107. POWER TRANSMISSION AND DRIVES	105. Piping symbols	105-110. CENTRE OF GRAVITY
Study of shafts, axles, couplings and clutches used on various machines. Locating & identifying these elements on various machines. Dismantling clutch mechanisms. Study of standard machine elements. Cleaning & inspection of parts for any damage/wear out etc. & carrying repairs for replacement. Assembly & oiling of clutches & fitting back to its location. Testing for operation. Preparation of reports.	Prime movers, Types of drives—Rope and chain. Variable speed transmission PIV drives and Harmonic drives. Friction drives, Clutches—Positive clutches, friction clutches. Mechanical, Hydraulic & pneumatic drives—basic principles & uses. Individual drive and group drive. Care maintenance of different types of drives and their applications. Study of individual drive system, Reciprocating, reverse, eccentric, cams, cranks drives. Rotary to linear drives & <i>vice-versa</i> . Power transmission elements Shafting—line shaft, types to shafts—rigid flexible & hollow.	106. Applications of piping symbols on drawings. 107-108. Types of pulleys (e.g., Flat pulley, "V" belt pulley, Rope pulley etc.)	Centre of Gravity & centroid. Position of Centroid of plain geometrical figure. Position of centre of gravity of regular solids. Centre of gravity of irregular plain lumina. State of equilibrium. Condition of stability of a body. 105-116. TRIGONOMETRY Addition formulae sin (A + B). Subtraction formulae. Double angle & half angle. Height & distance. Graphs of functions. Practice problems. Solution of triangle. Taper calculations (Advanced). Calculations of simple coordinate distances. Practice problems. Advanced problems in measurement.

FORGING EQUIPMENTS

1	2	3	4	5
1.	Cast Iron Forge 1m x 1m x 1m with blower		1 no.	1 no.
2.	Black smithy's Anvil, 200 Kg.		1 no.	1 no.
3.	Smiths Tongs, Hollow bit, ariths tongs flat (30 mm)		1 each	1 each
4.	Cold set with handle		1 no.	1 no.
5.	Hot set with handle		1 no.	1 no.
6.	Smiths Flatter A 65		1 no.	1 no.
7.	Block swage 300 x 300 x 1100 mm		1 set	1 set
8.	Drift in different sizes (6 to 25 by 3 mm)		1 set	1 set
9.	Top swaged 12.5, 20, 25 mm, Bottom swages 6, 12.5, 20 mm		1 set	set
10.	Smiths Top Bottom Fuller		1 no.	1 no.
11.	L. Square (30 x 30 x 40 cm)		1 no.	1 no.
12.	Spade		1 no.	1 no.
13.	Rake		1 no.	1 no.
14.	Pokar		1 no.	1 no.
15.	Sprinkler		1 no.	1 no.
16.	Wing compass 200 mm		1 no.	1 no.

ERECTION TOOLS

1.	Foundation bolts	8 nos.	8 nos.
2.	Plum bob	1 no.	1 no.
3.	Square Box Wrenches	1 no.	1 no.
4.	Square T Wrenches	1 no.	1 no.
5.	Engineers Square 700 mm	1 no.	1 no.
6.	Threaded Fastener B Type	1 no.	1 no.
7.	Threaded Fastener C Type	1 no.	1 no.
8.	Threaded Fastener F Type	1 no.	1 no.

EQUIPMENTS FOR ELECTRICAL MAINTENANCE

1.	Neon Tester 500 V double prove type	1 no.	1 no.
2.	Test lamp 200 V, 25 W	1 no.	1 no.
3.	Hand Technometer with male & female Rubber plugs & Resins case.	1 no.	1 no.
4.	Moving iron ammeter portable type 0 to 15 Amp.	1 no.	1 no.
5.	Multi meter (AVO)	Nil	1 no.
6.	Insulated Screw Driver 150 mm.	Nil	each
			1 no.

GUIDES AND GUIDEWAYS

Inspection of machine guideways & slides.
Checking for straightness, flatness, Scoring/scuffing marks & condition of oil grooves & wear.
Adjustment of gibs, wedges for setting the gap. Use of fillers, gauges and dial indicator.
Study of feed mechanism—Revolving, dismantling, cleaning & re-coiling of its machine elements
Assembly & fitting back to its position. Testing for its operation.

Mechanism to be studied—Lathe machine—carriage, apron, feed box, head stock etc.

Filling machine—feed box (column, knee, saddle), rapid traverse gear box, intermediate gear box etc.

108-109. PULLEYS

Types of pulleys—solid, split, "V" groove, step, cone, taper, guided & jockey or rider pulleys etc. their functions & uses...
Specifications & selection of pulleys for specific application. Necessary calculations for deciding the size—diameter, width, weight etc.
Crowning of pulleys.
Fast and loose pulleys.

109-111. Various types of couplings Flanged couplings, Muff couplings, Universal couplings, Flexible Coupling, Oldham coupling etc.)

PAIRS OF MACHINE ELEMENTS

110-111. BELTS

The object of belts—Types/Sizes/Specifications & uses.

Materials used for belts—Leather, Cotton, Canvas, Indian rubber (Batala).

Selection of the type of belt with the consideration of load & tension.

Leather belts/methods of joining the ends/bolting leather belt & their specific advantages.

V Belts—standard specification, advantages & disadvantages.

Belt fasteners—different types, advantages & disadvantages of each other.

Clutching & repairing of broken wormout gears, shafts, pulleys, clutches, flanges etc. & putting back in the position.

Identification of key ways & reaming wormout keys.

Reaming of damaged glands, shafts, oval & mounting of roller bearings.

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111-118. SIMPLE MACHINES

Definition & terms connected with simple machine. Mechanical advantage & Velocity ratio. Input, Output, efficiency & Ideal machine. Problems on mechanical advantage Velocity ratio & Efficiency.
Lever & principle of Lever. Kinds of Lever, Cranked Levers. Pulley-fixed & movable. Problems on simple machines.

112-113. **BELT DRIVES**

Types of belt drives, velocity ratio of belt drive, Horse power transmitted by belt. Ratio & driving tension in a belt.
Parallel & cross belt drive open & cross belt drive, angular belt drive.
Geometrical explanation of the belt drives at an angle.
Belt speeds used for commercial belts.

Calculation for the size of the new belt.

Slipping off the belts— causes & remedies.

Use of guide pulleys, crowning, use of dressing & resin powder to avoid creep & slipping.

112. As per BIS conventional representation of Engineering materials.
113. As per BIS Conventional representation of common features in Engineering drawing.

114. **CHAINS AND SPROCKETS**

Use of chains, wire ropes for power transmission.
Methods of fixing & uses. Types brief description.

115-117. **COUPLINGS**

Types—Rigid coupling, Flange coupling, Hook's coupling, Universal coupling, Flexible couplings, their different uses.

CLUTCHES—Types & uses.

118-119. **KEYS**

Pre-requisites of a Key—prevention of circular/longitudinal motion of machine parts.
Types of keys & Keyways, their uses & applications.
Preparation of Keys, allowable tolerance, Clearances.
Keyfitting procedure—methods.
Procedure for removing keys.
Types & uses of Key pullers.
Use of Keys in Power transmission.

114. Introduction to Oblique Projection. Types of Oblique projection (Cavalier and Cabinet)

115. Exercises on Oblique projection.

116. Introduction to surface development of various solids.

117. Surface development of Prisms and Cylinders.

118. Surface development of cut prisms & Cylinders.

119. Surface development of pyramids.

117-123. **WORK, POWER, ENERGY & EFFICIENCY**

Advanced problems on Work, Power, Energy & Efficiency & cost of power consumption. Practice problems.

PREVENTIVE MAINTENANCE
3
3 check list for prevention of all types of general purpose material handling equipment at treatment furnaces, machines, hydraulic etc.

g machines for prevention as per scheduling as per list.
g preventive maintenance for all machines in the workshop.
in carrying out prevention work as per it & schedule.

on & lubrication of the, as per instruction & ; Understanding of col- e used for lubricating

120-124. **GEARS AND GEARINGS.**

Types-materials & uses of gears.
Various manufacturing processes.
Study of spur gear elements-Tooth profile-Pitch Circle-Diametral Pitch-Velocity ratio of a spur gear.
Helical, Herring bone Bevel, Spiral Bevel, Hypoid gears.
Rack & pinion-Worm & Worm wheel gearing. Velocity ratio of wheel gearing.

Repairs to gear teeth by binding up & dovetail insert method.
Method of fixing geared wheels for various purpose drives.
General causes of the wear & tear of toothed wheels & their remedies.

Methods of fitting Spiral gears, Helical gears. Bevel gears, Worm & Worm wheels in relation to required drives.
Care & maintenance of gears.

119-122. **SIMPLE AXLE & WHEEL**

Differential Axle & Wheel.
Single & Double Purchase crab. Inclined plane. Simple plane-Simple Screw jack. Practical applications & problems.

124-128. **GEAR, BELT AND ROPE DRIVE**

Advanced problems on power transmission. Estimation of work, Power, H.P. in transmission. Practice problems. Determination of speed & size of pulleys & gears, Practice problems.

d keeping of log cards and ne history cards.

125-129. **MACHINE FOUNDATION**

Methods employed for installation & erection of precision & heavy duty machines.
Location & excavation of foundation.
Different types of foundations-structural, reinforced, wooden, isolated foundations.
Foundations for heavy machines-special precautions necessary for erecting precision machines.
Importance of isolated foundation. Special processes involving in erection of heavy duty machines.
Layout of machines-consideration of power, space, weight, ventilation & moving parts etc.
Types of vibrations, causes & prevention of vibrations.
Methods of insulation of machine against vibration.

125. Lines of intersection of plain surface to plain surface.
face.

126. Lines of intersection of plane surface to curved surface.

127. Lines of intersection of curved surfaces to curved surfaces.

128. Freehand sketching of Reamer, Center, punch, Twist drill, Taper shank etc.

129. Freehand sketch of Leg vice.

123-128. **DENSITY, SPECIFIC GRAVITY**

Density-Definition, Unit.
Specific Gravity.
Archimedes principle. Use of various formulae for finding out density & specific gravity. Floatation of a body-applications, hydrometers-principle & use. Difference between Force & Pressure.

129. Revision.
129-130. **REVISION & TEST**

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Anti-vibration devices & their locations.

Different types of instruments used for checking the vibrations.

130. REVISION & TEST.

130. TEST

130. TEST.

130. TEST

131-133. Preventive maintenance (contd.)

131-132. LEVELLING OF MACHINES

Levelling of machines, importance of levelling.

Methods of grounding.

Use of machine levelling screws.

Methods of levelling, precautions to be taken while levelling, levelling accuracy—its measurement.

Special precautions necessary for precision machines.

use of Spirit level, its construction & use.

Use of Camel back, straight edges & slip gauges for levelling.

133-135. MACHINE ALIGNMENT

131. Dimensioning of Tapered components.

132. Dimensioning of Keyways.

131-150. MECHANICS
Introduction to mechanics.
Force-units & its effect. Elements of Force. Representation of force. Resultant of force. Resultant force & Equilibrium. Composition of forces. Law of parallelogram of forces. Law of triangle of forces. Law of polygon of forces. Algebraic method, trigonometric method problems on mechanics.

131-134. GEARS & GEARING

133. Tolerance Dimensioning.

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Machine Alignment—different types—procedure.

Equipment for alignment machine—use of Test mandrel, master cylinder, Straight edge, Contraction, Slip gauges, dial indicators etc.

Precautions to be observed in the use of equipments while aligning.

Special precautions necessary for erection, levelling & aligning precision machines.

Testing for correct functioning of machine parts, machine commissioning.

134. Types of Rivet heads.

Gear elements. Pitch calculations and conversion Gear tooth proportion. Practice problems.

134-143. BREAKDOWN MAINTENANCE

Basics of breakdown maintenance. Practicing diagnosis of faults.

Breakdown maintenance of machines & Equipment available in the workshop.

136-138. TESTING OF MACHINE TOOLS.

Introduction to testing of machine tools.

ISI & Schleischinger Standards.

135-136. Types of Riveted joints (Lap & Butt)

137. Forms & ends of set screws.

138. Types of nuts with their standard proportion.

135-141. COPLANAR FORCES

Law of Triangle of forces. Parallelogram Law of Forces. Equilibrium of Forces. Condition of equilibrium of forces. Application to lifting Tackles. Practice

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tice problems.
142-154. **CALCULATION OF BLANK SIZES**
Length of double bent strips, weight of strips, bar stocks, castings etc. Percentage of scrap from strip of various blank layouts. Practice problems. Measurement of large radii & bores. Spirit level. Practice problems. Wire measurement of screw threads-2 wire method, 3 wire method. Practice problems.

139-145. **REPAIRS & RECONDITIONING**
Methods of repairing damaged parts. Major overhauling. Reconditioning of machines-Methods of reconditioning-measuring instruments used in reconditioning-special tools, test man-

139. Types of bolts.
140-141. Various types of locking arrangements for Nuts.
142. Various types of foundations bolts.
143-144. Various types of keys with standard propor-

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drels, spotting gauges, bridges used in reconditioning-testing of machines after repair.
Preparation of test chart.
Methods of testing various set-ups.
Reclamation of worn-out parts such as slides, gears, shafts, broken parts of cast iron etc. by metal deposition-hard chrome plating etc.
Conservation of wear, forms of wear.
Introduction of special tools used in maintenance-vibrometer, Tachometer, Spirit level etc.
Materials used for leakproof joints.
Preparation gaskets and their mounting procedures.
Sealing & Packing elements.
Detection of common faults & their rectification in general.

145. Cotter & Cotter joints. (Socket & Spigot).

144-155. **RECONDITIONING**
Re-conditioning of small machines

146-147. **SEALS AND PACKINGS**
146. Cotter joint with sleeves.

e tools such as bench drill-
 machine, pillar type drilling
 machine, bench grinder, pedes-
 rinder, tool & cutter, cool-
 umps etc.
 onditioning of General pur-
 & special purpose ma-
 ss, Air compressors etc.
 iding misalignment prob-
 , Alignment of different
 of machine tools as per
 sangers standards.
 oup of 16 Apprentices must
 idition 4 number of ma-
 tools as a "project".

Introduction to Seals & Packings-
 types, their functions.
 Storage of Seals, filters & their
 specifications.
 Methods of fault finding-rectifi-
 cation & remedies.
 Installation commissioning.
 Air venting & Cavitation.
 Regular care of Hydraulics.

147. Strap joint with Jib &
 Cotter.

148-153. RECONDITIONING

154-155. MAINTENANCE

RECORDS

Preparation of maintenance sched-
 ules. Use of maintenance cards,
 Log cards, History cards & re-
 cording the data.
 Reference of machine manuals-
 how to use them.
 Plant code system.

148. Pin or knuckle joint.
 149. Pipe joints, Socket and
 spigot joint.
 150. Hydraulic joints, CI
 flanged joint.
 151. Freehand sketching
 different types of locking.
 152. Various types of bolt
 heads.

151-154. **FRICTION**
 Limiting Friction, co-effi-
 cient of Friction & Laws of
 Static friction. Problems on
 Friction.
 155-156. **REVISION &
 TEST**

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Spare parts procurement.
 Planning spare parts manufactur-
 ing.
 Maintenance stock level.

153. Metric screw threads.
 154. Freehand sketching of
 Rivet heads and Riveted
 joints.
 155. Revision.

SION & TEST.

156. TEST.

156. TEST.

157-167. **TRIGONOM-
 ETRY**

Application of Sine Bar,
 Precautions while checking
 inclined surfaces by using
 Sine Bar. Practice prob-
 lems. Coordinates. Ad-
 vanced problems.

SYLLABUS FOR THE TRADE OF MACHINE TOOL MAINTENANCE
UNDER APPRENTICESHIP TRAINING SCHEME
PERIOD OF TRAINING – 4 YEARS
 FIRST, SECOND, THIRD YEAR : SAME AS CRAFTSMAN TRAINING SC
 FOURTH YEAR OF TRAINING : 1 TRADE PRACTICAL

INPLANT TRAINING

S.No.	Area of Training	Period
1.	Practice of installation of machine tools – foundation, installation & testing. Insulation of machines against vibrations. Use of antivibration countings.	
2.	Installation of power hammer, compressors furnaces etc.	
3.	Manufacturing of parts to be replaced and special tools/gadgets/fixtures etc. used in Maintenance section	
4.	Reconditioning of general purpose machines. Air compressors, pumps etc.	
5.	Preventive maintenance	
6.	Breakdown maintenance	
7.	Repairs of wornout parts	
8.	Preventive/Breakdown maintenance work on Hydraulic/Pneumatic systems.	
Total weeks		

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2. TRADE THEORY

Inspection and quality control

- 157-161. Definitions and methods.
 Latest trends – use of Laser beam.

162-166. WORK STUDY

- Method study & work measurement. Shop layout and machine layout.
 ENGINEERING MATERIALS – NON-METALLIC
 Use of non-metallic materials– Plastic, Nylon, Teflon, Epoxy, Rubber, Foam–in Engineering c
 Mechanical, Physical properties and machining of these materials.

- 167-170. Application in the construction of machine tools.
 INDUSTRIAL AUTOMATION AND ROBOTICS
 Use of Manipulators and Robots for Engineering operations.

- 171-174. Welding and painting robots.
 Robots for loading/unloading operations.

JIGS AND FIXTURES

- 175-179. Definition and principles.
 Points to be considered while designing Jigs & Fixtures.
 Method of Location, Loading and Unloading.
 Clamping types & power devices used for clamping.
 Fool proofing, ejection & removal.
 Rigidity and stability to avoid vibrations.
 Table fixing arrangement.
 Safety devices necessary while in use.

180. TEST.

DRILLING MACHINES

181-184. Types, Sizes & specification of drilling machines.

Special features of Radial Drilling, Precision Drilling, Multiple Spindle Drilling, and Automatic Drilling machines. Study of speed & feed changing mechanisms of these machines.

Care and maintenance.

185-189. BORING MACHINES

Types – Horizontal, Vertical, Jig boring machines.

Work holding devices and Tool mounting methods.

Mechanisms and operation.

Care and maintenance.

190-192. SLOTTING MACHINES

Types, specifications and functions.

Study of driving mechanism.

Variable speed reversible drive mechanism.

Hydraulic drive mechanism.

Study of slotter operations.

Care and maintenance.

193-196. PLANNING MACHINES

Types, specifications & Use.

Table drive mechanism—open & cross belt drive, reversible motor drive & hydraulic drive.

Planer feed mechanism by friction disc & electrical drive.

Work holding & standard clamping devices.

Difference between Shaper and Planer – Operation & mechanism.

Care and maintenance.

197-201. NON-CONVENTIONAL MACHINE TOOLS

Constructional features, principles of operation, application of spark erosions, Wire EDM, Copying/Tracing, Laser cutting machines in an Engineering Industry.

Study of Ultrasonic and chemical machining processes.

202-204. AIR COMPRESSORS

Compressed air production. Rotary & reciprocating type of Compressors. Use of coolers.

Pressure control—Use of safety valves and Governors.

Purification of Air. Use of Filter units.

Care and maintenance.

205-208. REVISION AND TEST.

3. ENGINEERING DRAWING

157-159. Details & Assy. of Clapper Box.

160-162. Details & Assy. of Screw jack.

163-164. Surface roughness symbols & their applications.

165-166. Tolerances of form & position & their applications.

167. Introduction of Jigs & fixtures & different elements of Jigs & Fixtures.

168. Locating devices.

169. Clamping devices.

170-171. Types of simple Drilling jogs.

172-173. Foundation drawings of machine tools (e.g., Lathe, Milling m/c, Drilling m.c. etc.)

174-176. Layout drawings for installation of machines & equipments.

177-179. Drawing of Lubrication & Coolant system.

- 180. Freehand sketching of different types of Gauges, Snap, Ring etc.
- 181. Freehand sketching of Sine Bar & Combination set.
- 182. Test
- 183-185. Details and Assy. of Bench Vice.
- 186. Gear Terminology.
- 187. Spur Gearing.
- 188-189. Bevel Gearing.
- 190-191. Helical Gearing.
- 192-193. Worm & Worm Gearing.
- 194. Introduction to Cams.
- 195. Various types of Cams.
- 196-198. Freehand sketching practices of Hand tools to relates Trades.
- 199-201. Practice on missing views & missing lines.
- 202-205. Practice on Orthographic projection.
- 206-207. Revision & solving of old NCVT papers.
- 208. Final Test.

4. WORKSHOP CALCULATION & SCIENCE

- 157-164. **HEAT**
Importance, sources and effect of heat. Nature of heat and temperature. Temperature measuring devices. Different temperature scales. Problems on temperature scales. Specific Heat. Measurement of specific heat. Renault's calorimeter. Problems on Specific heat.

cific heat. Linear expansion of solids. Expansion of solids-Axial & Volumetric. Problems on expansion of solids. Expansion of liquids. Expansion of gases. Absolute zero & scale. Transformation of heat.

165-170. ATMOSPHERIC PRESSURE

Atmospheric pressure & its measurement. Barometers - types. Fortin's barometer. Properties of Gases. Pumps working on atmospheric pressure. Problems on Pumps.

171-180. ELECTRICITY

Nature of Electricity. Conductors & Insulators. Units of Current, Voltage & Resistance. Specific Resistance & problems. Ohm's Law. Problems on Ohm's Law. Parallel & Series circuits. Problems on Parallel & series circuits. Electrical Power - Units & problems on power.

181. REVISION.

182. Test.

168-171. MEASUREMENT AND GAUGING

Limits and tolerances. Limits systems. Miscellaneous measurement problems.

172-173. CALCULATIONS FOR CUTTING

BORING
Effect of tool height while taper turning. Cutting tool life. Practice problems.

176-180. ADVANCED PROBLEMS FOR ESTIMATION

Advanced problems for estimation of time, Height & cost of simple machines.

181-182. REVISION & TEST.

183-185. **MAGNETISM**
Magnets – uses & properties of magnets. Artificial Magnets.

186-203. **GENERAL PHYSICS**

Advanced problems on Work, Power & Energy, Springs—properties & uses. Simple spring calculations.
Properties of Liquids.
Advanced problems on – Velocity & Acceleration.
Mechanical equivalent of heat.
Problems on mechanical equivalent of heat.
Pyrometers, Thermocouples, Segar cones etc.
Advanced problems on mechanics.

204-208. **REVISION AND TEST.**

206-209. **REVISION AND TEST.**

SOCIAL STUDIES

The Syllabus has already been approved and is same for all the trades.

183-194. **WORK, POWER, ENERGY & E**
Advanced problems on Work, P
Efficiency. Electrical power-pow
cost. Practice problems.
ADVANCED PROBLEMS.
– Blank sizes
– Length of doubles bent
– Weight of Castings.

Sl. No.	Name of Tools and Equipments	IS : Code	Existing Quantity	Prop Quantity
1.	Steel Rule 15 cm Graduated both side in Metric & English	IS : 1481-1970	17	5
2.	Inside Spring Caliper 150 mm	IS : 4052-1967	17	5
3.	Outside Spring Caliper 150 mm	IS : 4052-1967	17	5
4.	Divider Spring 150 mm	IS : 4083-1967	17	5
5.	Hermaphrodite Caliper 150 mm	IS : 4083-1967	17	5
6.	Try Square 150 mm	IS : 2103-1962	17	5
7.	Hack Saw frame adjustable 250-	IS : 5169-1969	17	5
8.	Hammer ball pein 200 gm with handle.	IS : 841-1963	17	5
9.	Hammer ball pein 400 gm with handle.	IS : 841-1963	17	5
10.	Cold Chisel 20 × 200 mm	IS : 402-1964	17	5
11.	Cross Chisel 10 × 150 mm		17	5
12.	Half Round Chisel 10 × 150 mm		17	5
13.	Diamond point Chisel 10 × 150 mm		17	5
14.	Centre punch 100 mm	IS : 7177-1974	17	5
15.	Prick punch 100 mm		17	5
16.	File flat Bastard 300 mm	IS : 1931-1972	17	5
17.	File flat 2nd cut 250 mm		17	5
18.	File flat Bastard 350 mm		17	5
19.	File flat smooth 200 mm		17	5
20.	Round nose piler 200 mm		17	5
21.	Combination piler 200 mm	IS : 3650-1973	17	5
22.	File half round 2nd cut 250 mm	IS : 1931-1972	17	5
23.	File three square smooth 200 mm		17	5
24.	File round smooth 200 mm		17	5
25.	File square smooth 200 mm		17	5
26.	File needle set of 12 nos.	IS : 3152-1965	17	5
27.	Scraper A 250 mm (Bearings)		17	5
28.	Scraper B 250 mm (Triangular)		17	5
29.	Scraper D 250 mm (Half Round)		17	5
30.	Spindle blade screw driver 100 mm	IS : 844-1962	17	5
31.	Allen Hexagonal keys 2 to 16 mm		17	5
32.	Card file		17	4
33.	Scriber 150 × 3 mm (One side off-set)		17	as

TOOLS AND INSTRUMENTS FOR MAINTENANCE SHOP				
1	2	3	4	5
1. Master bar 45° scraping bar 600 mm with width of bar 75 mm thickness 25 mm all sides to an accuracy of 0.02 mm seasoned.	1	1	1	1
2. Master flat-scraping test bar 600 mm length 75 x 75 mm square in cross section all sizes scraped to an accuracy of 0.02 mm per 300 mm seasoned.	1	1	1	1
3. Tap and die set M6 to M12 with necessary tap wrench and die holder.	1 set	1 set	1 set	1 set
4. Spanner socket set of 25 pieces (10 to 25, 27, 30, 32 mm = 18 pcs and accessories = 7 nos.)	1 set	1 set	1 set	1 set
5. Hammer soft (faced 30 mm dia.) plastic tipped.	4	1	1	1
6. Pipe wrench 450	as required	as required	as required	as required
7. Chain pipe wrench 650	2	1	1	1
8. Self alignment Roller ball bearing IS : 4025-1967.	1	1	1	1
9. Telescopic gauges 13 mm to 300 mm.	1 set	1 set	1 set	1 set
10. Lubricant trolley 2400 x 1200 x 1200 mm (8 chamber)	1	1	1	1
11. Collapsible tool kit 5 compartments	Nil	1	1	1
12. Tap Extractor	1	1	1	1
13. Gear pump	1	1	1	1
14. Vane pump fixed and variable delivery	1 each	1 each	1 each	1 each
15. Piston pump (Radial x Axel)	1 each	1 each	1 each	1 each
16. Linear Actuator (differential and non-differential)	1 each	1 each	1 each	1 each
17. Hydromotor	1	1	1	1
18. Accumulator (Spring & Gas)	1	1	1	1
19. Pneumatic tools (Portable nut spanner/runner, chisel, grinder sander and hammer.)	1 each	1 each	1 each	1 each
20. Hydraulic, Pneumatic trainer with necessary aggregates for different	1 each	1 each	1 each	1 each

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machine circuit with all types of transparent valves and pressure gauge, reservoir etc.				
1	2	3	4	5
21. Hydraulic valves (Relief, Sequence, Unloading, Pressure-reducing, Check, flow control, Directional Control Valves etc.)	1	1	1	1
22. Transparent Hydraulic cylinder	1	1	1	1
23. Transparent gear pump	1	1	1	1
24. Transparent vane pump	1	1	1	1
25. Cut model of pneumatic valves	1	1	1	1
26. Vibrometer	1	1	1	1
27. Flow detector (Magnetic crack detector)	1	1	1	1
28. Machine tool calibrator	1	1	1	1
29. Lash tool dynamometer	1	1	1	1
30. Engg. Stethoscope	1	1	1	1
31. Stud. Extractor	1	1	1	1
32. Tool picker collate type	1	1	1	1
33. Tool picker magnetic type	1	1	1	1
34. Magnifying glass 75 mm	1	1	1	1
35. Pin spanner set	1	1	1	1
36. Hand Keyway breacher	1	1	1	1
37. Granite surface plate 1600 x 1000 with stand and cover	1	1	1	1
38. C.I. Surface plate 400 x 400 mm with wooden stand and cover	1	1	1	1
39. Solenoid valve	1	1	1	1
40. Pneumatic motor	1	1	1	1
41. Head lamp	1	1	1	1
42. Bearing and gear tester	1	1	1	1
43. Pneumatic scraper with adjustable stroke	1	1	1	1
44. Hydraulic wheel and bearing puller	1	1	1	1
45. Master test bars (Different sizes)	1	1	1	1
46. Level bottle (Spirit) 150 mm	1	1	1	1
47. 3 Cells Torch	1	1	1	1

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	1	2	3	4	5
51. Flaring Tool	1 no.	1 no.	1 no.	1 set	1 set
52. Tube Expander upto 62 mm	1 set	1 set	1 set	1 set	1 set
53. Circlip Pliers (inside and out side & straight)					
54. SRDG Ball Bearing, DRDG Ball Bearing, Self aligning Ball Bearing, SRAC Ball Bearing, Needle bearing, Thrust type Bearing, Plain Bush Bearing, Thin Walled Bearing, Thrust Roller Bearing.					
55. Sledge Hammer 5 kgs.	1 no.	1 no.	1 no.	1 no.	1 no.
56. Viscometer					

PRECISION INSTRUMENTS

	1	2	3	4	5
1. Vernier height gauge 500 mm	1	1	1	1	1
2. Vernier Bevel protractor with 150 mm blade	1	1	1	1	1
3. Vernier Caliper A200 with Inside & depth measurements	1	1	1	1	1
4. Direct reading Vernier Caliper B300 (Direct reading with dial)	1	1	1	1	1
5. Optical Bevel protractor	1	1	1	1	1
6. Outside micrometer 0 to 25 mm	1	1	1	1	1
7. Outside micrometer 25 to 50 mm	1	1	1	1	1
8. Outside micrometer 50 to 75 mm	1	1	1	1	1
9. Outside micrometer 75 to 100 mm	1	1	1	1	1
10. Combination set with 300 mm blade centre head, Square head and protractor head.	1	1	1	1	1
11. Sinebar 200 mm	1	1	1	1	1
12. Slip gauge (in sets) metric Normal (for the whole Institute)	1	1	1	1	1
13. Internal micrometer 5 to 30 mm	1	1	1	1	1
14. Vernier gear tooth Caliper (metric)	1	1	1	1	1
15. Bevel gauge 200	1	1	1	1	1
16. Dial gauge Type-1 Gr. A (complete with clamping devices and stand)	2 nos.	2 nos.	2 nos.	2 nos.	2 nos.

MASONARY

	1	2	3	4
20. Centre gauge 50" x 4" x 17"	1	1	1	1
21. Centre gauge 60"	1	1	1	1
22. Plug gauge, Plain (Designation of taper as per table I)	1 set	1 set	1 set	1 set
23. Ring gauge Morse taper No. 1, 2, 3, 4.	1 set	1 set	1 set	1 set
24. Ring gauge 5 to 25 mm by 2.5 mm (Go and No Go)	1 set	1 set	1 set	1 set
25. Limit plug gauges 5 to 25 mm by 2.5 mm.	1	1	1	1
26. Wire gauge	1	1	1	1
27. Bore dial gauge (0.01 mm dial)	1	1	1	1
28. Indicator with Magnetic base	1	1	1	1
29. Straight edge 485 mm to 1445 mm	1 set	1 set	1 set	1 set
30. Adjustable micrometer spirit level to measure flatness, inclination and taper with prismatic measuring base.	1 set	1 set	1 set	1 set

PAINTER

	1	2	3	4
1. Wooden straight edge 300, 600, 900, 1200 mm	1 each	1 no.	1 no.	1 no.
2. Man-on-chisel	1 no.	1 no.	1 no.	1 no.
3. Pick axes	1 no.	1 no.	1 no.	1 no.
4. Bar bending tools and cutting tools	1 no.	1 no.	1 no.	1 no.
5. Four fold foot rule	1 no.	1 no.	1 no.	1 no.
6. Plumb bob	1 no.	1 no.	1 no.	1 no.
7. Meson tool for Plaster work	1 each	1 each	1 each	1 each
1. Spray gun 1/2 Ltr.	1	1	1	1
2. Painting brush (various sizes)	1	1	1	1
3. Blow lamp	1	1	1	1
4. Mask	1	1	1	1

1.	Cylindrical Milling cutter B 63 x 90	IS : 1831-1961	1	1	
2.	Side and face cutter B 160 x 10	IS : 6308-1971	1	1	
3.	Side and face cutter B 160 x 10		-	1	
4.	Slot milling cutter B 10 x 6	IS : 6352-1971	1	1	
5.	Equal angular cutter 45°/100	IS : 6326-1971	1	1	
6.	Equal angular cutter 60°/100	IS : 6326-1971	1	1	
7.	Single angle cutter B 63 x 18 x 45°	IS : 6324-1971	1	1	
8.	Single angle cutter B 63 x 18 x 60°	IS : 2624-1971	1	1	
9.	Slot drill (Key setting) 3, 4, 5, 6, 8, 12 mm parallel shank	IS : 5031-1969	-	as	
10.	Slitting saw B 80 x 3		1	1	
11.	Slitting Saw B 100 x 4		1	1	
12.	Tee slot cutter to suit T headed bolt of 10, 12 mm S.S.	IS : 2668-1964	1	1	
13.	Concave milling cutter 4, 10, 20 mm	IS : 6322-1971	1	1	

MACHINIST TOOLS

3.	Centre drill A1 to 5.	IS : 664-1963	1	1	as
4.	Revolving centre with Arbor		1	1	required
5.	Knurling tool with holder (straight, cross, Diamond)	IS : 6335-1971	1	1	as
6.	Lathe Carrier upto 75 mm		1	1	as
7.	Oil stone 150 x 50 x 25 mm		1	1	required
8.	Oil, cane pressure feed 500		-	as	required
9.	Engg. file 50 lengths		1	as	required
10.	Boring tool holder (Armstrong) L.H. 8 and 10 sq. bit size x 200 length.		-	as	required
11.	Tool holder 8 and 10 sq. bit size		2	as	required
12.	Assorted H.S.S. tools for lathe shaper, slotter of different shapes and sizes.		-	as	required

10.	Corner rounding milling cutter 250 x 4, 10, 16 mm		-	1	
16.	Woodruff key seating cutters A 13.5 x 3, A 16 x 4, A 19.5 x 5, A 19.5 x 6		-	1	each
17.	End mill cutter SS 3, 6, 10, 12, 16, 18, 22 mm		-	1	each
18.	Milling gear cutter (Involute) 1, 2, 3, 5, 3 module set of 8 cutters		-	1	
19.	Fly cutter holder		1	as	
20.	Engineering parallels	IS : 4241-1967	1	1	set
21.	Scribing block universal 300 mm		4	nos.	
22.	Veeblock 100/7-80-A	IS : 2949-1964	1	pair	
23.	Straight edge (steel) 1000 mm	IS : 2220-1962	-	1	
24.	Spirit level 2 V 250; 05	IS : 5706	-	1	
25.	Spanner D.E.G.P. Series 2	IS : 2028-1968	1	1	set
26.	Table chuck 3 jaw with tightening arrangement & graduated degree.		1	1	
27.	Machine vice 200 mm swivel base		1	1	
28.	Machine vice 160 mm swivel base		1	1	
29.	Angle plate size 4 with slots	IS : 2554-1963	-	1	
30.	Angle plate adjustable 250 x 150 x 175		-	1	
31.	Twist drill 3 to 13 (S.S.)	IS : 5701-5706	1	1	set
32.	Twist drill 13 to 25 by 1 mm	-1969	-	1	req
33.	Grinding wheel dresser (Diamond) 1.5 carret		1	1	
34.	"C" Clamp 150 and 200 mm		-	1	
35.	Hand reamer 6 to 25 by 1 mm	IS : 1836-1961	-	1	
36.	Punch letter set 4 mm		-	as	
37.	Punch Number set 4 mm		-	1	req
38.	Mandrel 120 mm long different sizes.		-	1	
39.	Wheel balancing stand with its accessories.		-	1	
40.	Pin punch 3 to 10 mm by 1 mm		-	as	
41.	Deep cutting hacksaw frame 300 mm		-	as	rec
42.	Machine Reamer 6 to 25 by 1 mm.		-	as	rec

WELDING WORK (GAS WELDING)

1	2	3	4	5
1.	Oxy acetylene welding Cylinder	1 no.	1	
2.	Welding hose P.V.C. flexible inter-Trolley	10 nos.	5	
3.	Hose coupling Nipples	2 nos.	2	
4.	Hose Protractor	2 nos.	2	
5.	Double stage Pressure regulator (oxgn.) and double stage pressure regulator (Acety.)	1 no.	1	
6.	High Pressure blow pipe with tips	1 no.	1	
7.	Gas cutting torch with cutting tips	1 no.	1	
8.	Welding gloves pair (Leather)	Nil	1	
9.	Goggles (4A) for Gas Welding	6 nos.	4	
10.	Spark lighter	6 nos.	2	
11.	Spindle key	Nil	1	
12.	Gas Welding table with fire bricks.	Nil	1	
ARC WELDING				
1.	D.C. Welding Generator 150-300	1 no.	1	
	Amps capacity with all accessories.	1 no.	1	
FOR HEAT TREATMENT				
1.	Black smith anvil 200 kg.	1 no.	1	
2.	Smith tongs hollow bit, smiths	1 no.	1	
3.	Tongs flat (30 mm)	1 each	1	
4.	Water tank (450 x 300 x 250 x 6 mm) plate	1 no.	1	
5.	Furness for Heat treatment	1 no.	1	
6.	Oil bath tank (for quenching)	• Nil	1	
	45 x 45 x 45 x C.M. x 6 mm thick plate	1 no.	1	
FOR ELECTRONICS				
1.	Diagonal cutter 35 mm.	-	1	
2.	Transducer	-	1	
3.	Thermocouples kit	-	as	requ
4.	L.D.R.S. kit	-	as	requ
5.	Thermistors kit	-	as	requ

1	2	3	4	5
1.	Old Centre lathe	2	2	
2.	Old Milling Machine (Universal)	1	1	
3.	Old Grinding Machine (Universal)	1	1	
4.	Old Shaping Machine	1	1	
5.	Old Press (Power)	1	1	
6.	Old Turret and capstan lathe	1	1	
7.	Universal Indexing head	-	1	
MACHINES FOR REPAIR & RECONDITIONING				
1.	Lathe general purpose all geared attachment.	-	2	
2.	height of centre 150 mm to below, between centre 1000 mm with 3 jaw and 4 jaw chuck, coolant, equipments, only.	1	1	
3.	Milling machine universal horizontal No. 1 with all attachments.	1	1	
4.	Surface grinding machine wheel dia 180 mm (or near) reciprocating table, longitudinal table traverse 200 mm (or near) full motorised supplied with magnetic chuck 250 x 120 mm and necessary accessories.	1	1	
5.	Cylindrical universal grinding machine.	1	1	
6.	Drilling machine pillar 20 mm capacity.	1	1	
7.	Bench grinder 250 mm wheel dia.	1	1	
8.	Flexible hand grinder 100 mm dia (lighter type)	1	1	
9.	Portable Drilling machine 6 mm capacity.	1	1	
10.	Tensile and brinell hardness testing machine.	1	1	
11.	C.N.C. Trainer	1	1	
12.	Shaping machine 450 mm stroke (motorised) with all attachments	1	1	
13.	Pipe bending machine (Hydraulic)	-	1	

with all accessories (with do all

1.	Forge power operated 458 mm.	1 no.	1 no.
2.	Dia. 150 mm blower.	1 each	1 each
3.	Metal cutting shears 350 mm (hatchet type and straight type)	2 nos.	2 nos.
4.	Mallet (Plastic or rose wood) rod and rectangular 75 x 75 x 150 mm.	2 nos.	2 nos.
5.	Conical mallet.	1 no.	1 no.

1	2	3	4	5
FURNITURE				
1.	Metal lockers 8 lockers type with individual locks 1980 x 910 x 480 mm.	2 nos.	2 nos.	5
2.	Metal Office chair with arm cane sit & back.	1 no.	1 no.	
3.	Metal office table with 3 drawers	3 nos.	1 no.	
4.	Work bench.	4 nos.	4 nos.	
5.	Metal Shelving rack open type 1800 x 900 x 500 mm with adjustable shelves.	1 no.	1 no.	
6.	Drawing desk.	1 no.	1 no.	
7.	Stool.	1 no.	1 no.	
8.	Black Board with easel Milky Glass with Graph lines.	1 no.	1 no.	
9.	Portable fire extinguisher water type (constant)	2 nos.	3 nos.	
10.	Galvanised Mild Steel fire bucket 4 litres.	4 nos.	4 nos.	

1	2	3	4	5
FURNITURE				
10.	A.C. Timer kit	-	-	required
11.	D.C. Timer kit	-	-	required
12.	Decimal counter kit	-	-	required
13.	D.C. Motor control kit	-	-	required

1	2	3	4	5
HOISTING EQUIPMENTS				
1.	Fork clips 02 Ton (capa)	Nil	1	
2.	Fork clips 05 Ton (capa)	Nil	1	
3.	Manilla ropes 12, 20, 30 mm dia.	1 each	1	
4.	Crow bars.	4 nos.	4	
5.	Rollers (Steel Tubes) 40 mm to 65 mm dia	10 nos.	8	
6.	Block of Timber (various sizes)	10 nos.	8	
7.	Portable jack	1 no.	1	
8.	Cargo winches 3, 5 tonnes	1 each	As	
9.	Wall hoist	1 no.	As	
10.	Travelling & Gantry cranks	1 no.	As	
11.	Shear legs (Tripod)	1 no.	As	
12.	Hand operated chain pulley Block	1 no.	As	
13.	Mobile crank	1 no.	As	
14.	Conveyor	1 no.	As	
15.	Elevators	1 no.	As	
16.	Ratchet chain pulley	1 no.	As	

1	2	3	4	5
ERECTION TOOLS				
1.	Foundation bolts	8 nos.	8	
2.	Plum bob	1 no.	1	
3.	Square Box Wrenches	1 no.	1	
4.	Square T Wrenches	1 no.	1	
5.	Engineers Square 700 mm	1 no.	1	
6.	Threaded Fastener B Type	1 no.	1	
7.	Threaded Fastener C Type	1 no.	1	
8.	Threaded Fastener F Type	1 no.	1	
9.	Hatchet stake.	1 no.	1	
10.	Snap River set A-3, B-4.	1 set	1	

FORGING EQUIPMENTS

1	2	3	4	5
1.	Cast Iron Forge 1m × 1m × 1m with blower		1 no.	1 no.
2.	Black smithy's Anvil, 200 Kg.		1 no.	1 no.
3.	Smiths Tongs, Hollow bit, ariths tongs flat (30 mm)		1 each	1 each
4.	Cold set with handle		1 no.	1 no.
5.	Hot set with handle		1 no.	1 no.
6.	Smiths Flatter A 65		1 no.	1 no.
7.	Block swage 300 × 300 × 1100 mm		1 no.	1 no.
8.	Drift in different sizes (6 to 25 by 3 mm)		1 set	1 set
9.	Top swaged 12.5, 20, 25 mm, Bottom swages 6, 12.5, 20 mm		1 set	1 set
10.	Smiths Top Botton Fuller		1 set	set
11.	L. Square (30 × 30 × 40 cm)		1 no.	1 no.
12.	Spade		1 no.	1 no.
13.	Rake		1 no.	1 no.
14.	Pokar		1 no.	1 no.
15.	Sprinkler		1 no.	1 no.
16.	Wing compass 200 mm		1 no.	1 no.

ERECTION TOOLS

1.	Foundation bolts	8 nos.	8 nos.
2.	Plum bob	1 no.	1 no.
3.	Square Box Wrenches	1 no.	1 no.
4.	Square T Wrenches	1 no.	1 no.
5.	Engineers Square 700 mm	1 no.	1 no.
6.	Threaded Fastener B Type	1 no.	1 no.
7.	Threaded Fastener C Type	1 no.	1 no.
8.	Threaded Fastener F Type	1 no.	1 no.

EQUIPMENTS FOR ELECTRICAL MAINTENANCE

1.	Neon Tester 500 V double prove type	1 no.	1 no.
2.	Test lamp 200 V, 25 W	1 no.	1 no.
3.	Hand Technometer with male & female Rubber plugs & Resins case.	1 no.	1 no.
4.	Moving iron ammeter portable type 0 to 15 Amp.	1 no.	1 no.
5.	Multi meter (AVO)	1 no.	1 no.
6.	Insulated Screw Driver 150 mm, 200 mm.	Nil	1 no. each
7.	Insulated combination side cutting plier 200 mm	Nil	1 no.
8.	Connector 100 mm	Nil	1 no.