



GOVERNMENT OF MAHARASHTRA
DEPARTMENT OF TECHNICAL EDUCATION

SYLLABI OF FOURTEEN DESIGNATED TRADES



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APPRENTICESHIP TRAINING UNDER THE APPRENTICES ACT, 1961

Group No. 1—Machinist of Trades Group—

- (1) Fitter.
- (2) Turner.
- (3) Machinist (Miller).
- (4) Machinist (Grinder).
- (5) Machinist (Shaper, Slotter and/or Planer).

Group No. 2—Foundry Trade Group—

- (1) Pattern Maker.
- (2) Moulder.

Group No. 3—Metal Working Trades Group—

- (1) Blacksmith.
- (2) Sheet Metal Worker.
- (3) Welding (Gas and Electricity).

Group No. 4—Electrical Trades Group—

- (1) Electrician.
- (2) Lineman.
- (3) Wireman.

Group No. 5—Building and Furniture Trades Group—

- (1) Carpenter.

**APPRENTICESHIP TRAINING UNDER THE APPRENTICES
ACT, 1961**

**Syllabi for Practical Training of Apprentices recommended by the Trade
Committee for the following Trades under Group No. 1.**

Group No. 1—

1. Fitter.
2. Turner.
3. Machinist (Grinder).
4. Machinist (Miller).
5. Machinist (Slotter, Shaper and/or Planer).

The period of training for this group will be 3 years consisting of basic training for a period of six months and shop training for the remaining period including allied trade training if any in respect of each trade under the group. The syllabus for basic training of the trades under this group will be as follows :—

Basic Training (6 months)

Fitting—4 months.

- (1) Use of steel rules, Engineers squares, scribes, and dividers for marking out from drawings both in inches and millimeters:
- (2) Use of hack-saw, filing to line, centre punch and different types of files.
- (3) Drilling and chain drilling.
- (4) Use of hammer and cold chisel. Grinding of cold chisel.
- (5) Use of inside and outside callipers.
Use of odd-leg callipers for centering.
- (6) Use of micrometers and verniers.
- (7) Drilling and tapping through holes and bottoming. Use of dies.
Cutting of different types of threads both British and Metric.
- (8) Use of flat scrapers and marking blue.

Accuracy to be achieved in filing at the end of the 4 months period to ± 0.04 in one inch.

Turning—1 month.

- (1) Setting up work between centres.
- (2) Use of side cutting tools. Parallel turning.
- (3) Stepped turning.
- (4) Taper turning with offset tail stock.
- (5) Use of knurling tool.
- (6) Thread-cutting with single point tool, vee-thread.
- (7) Use of chuck.
- (8) Use of facing tools.
- (9) Drilling using tail-stock.
- (10) Simple boring.

Should be able to do plain turning to an accuracy of $\pm \cdot 002''$ in 1" dia.

Taper and parallel to within $\pm \cdot 002''$ per ft. length. Grinding of simple turning tools to give correct front, top and side rakes.

Metal Work—1 month.

Simple forging *e.g.*, cold chisel. Hardening and tempering by colours. Simple soldering. Simple marking out of sheet metals. Cutting and bending simple fold joints. Identification of different types of steel, cast iron and non-ferrous metals.

Shop Training.

The syllabus for shop training will be as follows in respect of each of the trades under this group after the completion of basic training:—

1. FITTER.

Allied Trade Training—

Essential	..	Nil.		
Desirable	..	(1) Turning	..	.. 1/2 month.
		(2) Shaping, Milling and Drilling	..	.. 2 months.
		(3) Blacksmithy	..	.. 1 month.
		(4) Welding	..	.. 1 month.
		(5) Foundry	..	.. 1 month.

If an establishment has facilities for less than the five types of work mentioned, then the period relating to that type will be devoted to fitting (*i.e.* 2 years plus remaining months).

He shall be given training on the following :—

(1) Marking out, filing to dimensions and fitting to mating parts. Working from blue prints of engineering drawings dimensioned in inches or millimeters.

(2) Scraping journal bearings and cutting of oilways.

(3) Fitting of bearings.

(4) Lubrication of journal and ball bearings.

(5) Fitting of keys in keyways using correct material.

(6) Use of locking devices *e.g.*, split-pins, locking nuts, springwashers, tab washers and the like.

(7) Fitting and removal of studs.

(8) Removal of broken studs.

(9) Use of reamers and dowels.

(10) Scraping of flat surfaces.

(11) Assembly of machined parts and components.

(12) Sharpening twist drills to correct angles.

(13) Making of simple gauges and templates.

Accuracy for filing to $\pm \cdot 001''$

Desirable .. (1) Erecting and aligning the shafts and belting of any type of machine in general use in a factory.

(2) Jointing of flat belts.

(3) Simple pipe fitting, threading, bending and assembly.

(4) Simple rivetting.

(5) Use and fitting of oil seals.

(6) Use of radial drill.

(7) Lapping of gauges.

2. TURNER.

Allied Trade Training—

Essential .. Nil.

Desirable .. (1) Fitting and assembly of finished machine parts. 1 month.

(2) Shaping, milling and drilling .. 2 months.

(3) Blacksmithy 1 month.

(5) Welding and brazing 1 month.

(5) Foundry 1 month.

Remaining period in Turning—

- Essential ..
- (1) Working from blue prints of engineering drawings dimensioned either in inches or in millimeters.
 - (2) Turning between centres. Use of half-centres. Use of mandrels.
 - (3) Use of independent jaw chucks and setting up work.
 - (4) Setting up work using dial gauge indicators. Use of precision measuring instruments *e.g.*, micrometers, dial gauge comparators and etc.
 - (5) Turning of ferrous and non-ferrous metals to include cast iron, medium carbon steel, mild steel, brass, copper and alloy steels (where available). Use of appropriate coolants.
 - (6) Sharpening of simple lathe tools for each of the above materials to give correct tool angles and finish.
 - (7) Knurling on plain surfaces.
 - (8) Drilling and boring plain and taper holes.
 - (9) Grinding of twist drills to correct angles and forms and finish.
 - (10) Use of boring bars and floating tools.
 - (11) Cutting of recesses.
 - (12) Screw cutting—external and internal of various types. Square threads and multiple start threads (where possible).
 - (13) Use of formed tools and form turning.
 - (14) Changing of chucks and face plates.
 - (15) Simple eccentric turning.
 - (16) Setting up work—face plate. Balancing. Use of figs and fixtures.
 - (17) Lubrication and routine maintenance of lathes.

Desirable—

- (1) Use of tungsten carbide tipped tools.
- (2) Use of taper turning attachment.
- (3) Use of relieving attachment.
- (4) Cutting spiral grooves in bearing bushes.
- (5) Setting and operation of capstan and turret lathe.

Accuracy to be achieved in turning at the end of the apprenticeship must be able to turn to within \pm .0005" per inch dia.

3. MACHINIST (GRINDER).

*Allied Trade Training—**Essential—*

- (1) Turning—2 months.
- (2) Shaping, Milling and Drilling—2 months.
- (3) Hardening and tempering—1 month.
(case hardening if available.).

Desirable—

Fitting and assembly of finished machine parts—1 month.

*Remainder of the training period in Grinding—**Essential—*

- (1) Grinding of plain and cylindrical surfaces.
- (2) Mounting and balancing of grinding wheels.
- (3) Dressing and truing of grinding wheels.
- (4) Selection of suitable grinding wheels for different materials and operations.
- (5) Taper cylindrical grinding both external and internal.
- (6) Grinding long cylindrical work with the help of steady rest.
- (7) Grinding of flat and taper surfaces.
- (8) Use of jigs and fixtures suitable for grinding.
- (9) Grinding of lathe tools, tipped tools etc., to correct angles.
- (10) Knowledge of correct feeds and speeds and also coolants.
- (11) Routine maintenance and lubrication of grinding machines.
- (12) Working to blue-prints of engineering drawings in inches or millimeters to very fine degree to accuracy (atleast $\pm .0003$ ”).
- (13) Use of precision measuring instruments used for grinding work in the establishment.
- (14) Form grinding.
- (15) Face and shoulder grinding.
- (16) Final grinding to obtain good finish.

Desirable—

- (1) Grinding of milling cutters.
- (2) Grinding of taps and dies.
- (3) Grinding of reamers, drills.
- (4) Lapping and honing.
- (5) Setting up centreless grinders.
- (6) Use of universal grinding machines.
- (7) Thread grinding.

4. MACHINIST (MILLER).

*Allied Trade Training—**Essential—*

- (1) Turning—1 month.
- (2) Use of shapers, slotters and/or planers. Use of radial drill—4 months.

Desirable—

Foundry and/or Blacksmithy—1 month.

*Remainder Training period—**Essential—*

- (1) Marking out of castings and forgings, Setting up and operation of all types of milling machines.
- (2) Selection of the right machine and cutter for a particular job.
- (3) Working to blue-prints of engineering drawing either inches or millimeters.
- (4) Cutting speeds and feeds and also coolants used for each of these operations both for ferrous and non-ferrous metals.
- (5) Routine maintenance and lubrication of milling machines as available in the establishment.
- (6) Use of jigs and fixtures for these machines.
- (7) Use of precision measuring instruments used for these operations in the establishments.
- (8) Use of attachments (*e.g.* dividing head, indexing head etc.) for these machines as available.

Accuracy in the above machining operations to be of the order of $\pm .001''$

Desirable—

- (1) Spiral milling.
- (2) Milling of straight spurs and helical gears.
- (3) Milling of drop stamp dies.
- (4) Hob milling.

5. MACHINIST (SHAPER, SLOTER AND/OR PLANER).

*Allied Trade Training—**Essential—*

- (1) Turning—1 month.
- (2) Use of radial drill.

Desirable—

- (1) Foundry and/or Blacksmithy—1 month.
- (2) Milling—2 months.

*Remainder Training period—**Essential—*

- (1) Marking out of castings and forging, Setting up and operation of shaping, slotting and planing machines as available in the establishment.
- (2) Selection of the right machine and tool for a particular job.
- (3) Grinding of tools used for shaping, slotting and/or planing machines.
- (4) Working to blue-prints of engineering drawing either in inches or millimeters.
- (5) Cutting speeds and feeds and coolants used for each of the operations both for ferrous and non-ferrous metals.
- (6) Routing maintenance and lubrication of shaper, slotter and planer as available in the establishment.
- (7) Use of jigs and fixtures for those machines.
- (8) Use of precision measuring instruments used for these operations in the establishment.

Desirable—

Use of attachments *e.g.*, indexing head etc., for these machines as available.
Accuracy in the above machining operations to be of the order of $\pm .002$ ".

Syllabi for related theoretical instructions to the apprentices recommended by the Trade Committee for the following trades under Group No. 1.

Group No. 1—

1. Fitter.
2. Turner.
3. Machinist (Turner).
4. Machinist (Miller).
5. Machinist (Shaper Slotter and/or Planer).

*Period—*3 Years (6 hrs. per week for all subjects except social studies. One hour per week for social studies).

Minimum educational qualification for eligibility. Two standards below Matriculation or equivalent examination.

The Subject to be taught—

1. Workshop Mathematics (for first two years only).
2. Engineering Drawing (including geometrical drawing).
3. Shop Theory.
4. Social studies.

1. WORKSHOP MATHEMATICS.

(a) For first six months—

Applied workshop problems involving multiplication and division. Common fractions—addition, subtraction, multiplication and division, application of fractions to shop problems.

- Decimals* .. Addition, subtraction, multiplication. Conversion of decimals to common fractions. Reduction of common fractions to decimal fractions. Problems.
- Square root* . . . The square root of a perfect square. The square root of a whole number and a decimal.
- Percentage and its application.* Problems.
- Ratio and Proportion* Problems.
- Algebra* .. Algebraic symbols, addition, subtraction, multiplication and division of expression involving algebraic symbols. Simple equation and transposition—problems. Standard algebraic formulae e. g. $(a+b)^2$, $(a-b)^2$. Simple simultaneous equation with two unknown quantities.
- Mensuration* .. Areas of rectangles, squares, triangles, circles and regular polygons. Calculation of area, volume and weight of simple solid bodies, such as cube square and hexagonal prisma-problems.
- Metric system* .. Metric weights and measurements—units—conversion factors—problems.

(b) For the remaining period—

- Geometry* .. Properties of lines, angles, triangles & circle.
- Trigonometry* .. Trigonometric functions. Use of trigonometrical tables. Applied problems—principle of sinebar calculation of areas of triangles, polygons, etc.
- Logarithm* .. Use of logarithm tables for multiplication and division.
- Mensuration* .. Area of circle and ellipse. Volume and weight of regular cone, sphere. Calculation of area, volume and weight of simple hollow solids applied problems.
- Graphs* .. Plotting of points, plotting of graphs of simple equations, reading of graphs.

(As applicable to each trade).

Further problems on measurement. Calculation of speed and feed. Gear calculation. Paper and offset calculation. Calculation of simple and differential indexing and cutting of spirals. Calculation of speed of pulley and gear and determination of sizes for transmission. Simple calculation on work, power and energy.

2. ENGINEERING DRAWING.

(A) For first six months . . . (Object is to familiarize the apprentice with engineering drawings and enable him to do simple drawings himself)—

Reading of simple blue-prints.

Free hand sketching—straight lines, rectangles, square, circles, polygon etc.

Free hand sketching of simple solids such as cube, rectangular block cylinder and the views of these objects when looked perpendicular to its surfaces or axis.

Free hand sketching of nuts, bolts, rivets, washers, keys, screw threads, etc. with dimensions from samples.

Simple orthographic projection—1st angle and 3rd angle.

Views of simple hollow and solid bodies with dimension—use of different types of lines and symbols for drawing.

Simple isometric drawing—*isometric views of simple objects such as square rectangles, cube, rectangular block etc.*

(B) For the remaining period—

Use of drawing instruments, T-square and Drawing board.

Construction of the simple figures and solids as mentioned above with dimensions and titles.

Use of different types of scales in inches and millimetres.

Lettering numbers and alphabets.

Projection of straight lines in various positions.

Projection of square, rectangles, circles and polygons.

Projection of solid and hollow solids such as cone, prism, pyramid, etc.

Views of simple solids cut by section plane.

Development of surfaces of simple objects.

Construction of isometric scale.

Drawing of rivetted joints, different types of threads, bolts, nuts and locking devices, keys, cotters, different types of couplings, bearings, pulleys, gears, etc.

Free hand sketching of actual machine parts or engine parts—such as pistons, connecting rod, crank shafts, tail stock, tool post, engineer's vice, drill post and ratchet brace, etc.

Free hand drawing of detailed components from assemblies.

Reading of advanced blue-prints.

Code of practice for general engineering drawings to be understood and followed as published by Indian Standard Institutions (IS : 696-1955).

3. SHOP THEORY.

(A) For first six months—

- Safety precautions to be followed in the basic training centre.
- Description and application of simple measuring tools such as steel rule, callipers, verniers, micrometers, etc.
- Description of vices, types of hammers, cold chisels, files, screw drivers, hacksaws and proper method of using them.
- Method of marking objects with the help of marking table, divider, scribing block, Vee block, centre punch, odd leg callipers, etc.
- Method of using drills, taps, dies and reamers. Description of ratchet brace. Description of standard screw threads and forms.
- Different types of wrenches and their correct use. Method of using surface plate for scraping and description of different types of scrapers.
- Different types of locking and fastening devices e.g. nuts, bolts, rivets etc. and their uses in making joints.
- Brief description of construction and operation of lathe, drilling machine and pedestal grinder and the safety precautions to be observed while using them.
- Method of soldering and brazing ferrous and non-ferrous metals. Different types of fluxes and their uses.
- Description of hearth anvil and simple forging tools.
- Method of tempering chisel.
- Method of jointing sheet metals by folding, riveting and soldering.
- Brief description of simple jigs and fixtures used for machining operations. Holding and clamping devices.
- Mass—unit of mass. Force—the absolute unit of force. The weight of a body—unit of weight. C. G. S. and F. P. S. system of units.
- Work—unit of work—energy—power—unit of power. Friction. Simple problems on straight and bell crank levers.

(B) For the remaining period—

- Safety precautions to be followed in the shop.
- Properties and uses of cast iron, wrought iron, plain carbon steel, high speed steel, alloy steel, copper, zinc, lead, tin, aluminium, brass, bronze, solder and bearing metals.
- Meaning of tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility.
- Meaning of stress, strain, modulus of elasticity, ultimate strength, factor of safety and different types of stresses.
- Brief description of manufacturing processes of pig iron, cast iron, steel, copper and aluminium.
- Method of using precision measuring instruments such as inside and outside micrometers, depth gauges, vernier, dial indicators, slip gauges, sine bars, universal bevel protectors, etc.

- Mechanical advantage—velocity ratio—useful work—mechanical efficiency of a machine.
- Gears, belt and rope drivers—determination of horsepower, speed and size of pulleys and gears.
- Machines—determination of velocity ratio, mechanical advantage and efficiency of winch, pulley blocks, wheel and compound axle.
- Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tacks.
- Determination of force on the piston, ram, etc.
- Velocity and acceleration. Meaning of Centre of gravity and specific gravity.
- Description of a lathe and its accessories. Different types of turning tools used in lathes including tipped tools and their angles for different materials. Speed and feed for different materials. Use of coolants. Method of brazing tipped tools.
- Brief description of Turret, Capstan, Copying and relieving lathes, Layout of a job and sequence of operation and setting of the lathe accordingly. Accurate location of holes by tool makers buttons.
- Different types and elements of screw threads. Method of cutting threads by machine and checking and measuring of threads including metric threads and multi-start threads.
- Brief description of shaping, slotting and planning machines. Description of quick return motion mechanism of these machines. Various cutting tools and tool angles used in these machines and the operations that can be done in these machines. Speeds and feeds for different materials and use of appropriate coolants.
- Description of different types of milling machines and attachments and various operations that can be carried out on them. Different types of milling cutters. Cutting speed, feed and coolants for different materials. Dividing head and types of indexing. Elementary process of gear and gear cutting. Elementary process of cam milling.
- Description of different types of grinding machines and grinding wheels and their speed for grinding. Various operations that can be carried out on grinding machines. Speed, feed and coolants for different materials. Truing and dressing of grinding wheels.
- Checking and measuring of parts prior to each operation.
- Heat and temperature. Thermometric scales—Fahrenheit and Centigrade—conversion of Fahrenheit scale to Centigrade scale and *vice versa*. Measurement of temperature. Name and brief description of the instruments used in the workshops. Descriptive explanation of expansion of solids, liquids and gases due to heat—co-efficient of expansion. Brief description of transference of heat—conduction, convection and radiation.
- Heat treatment of metals—annealing, hardening, tempering, normalising and case hardening. Heat treatment of cutting tools.

Different types of gauges used for production work. Limit and systems of limits. Types of fits and tolerances.

Lubrication and routine maintenance of all types of machine tools.

Magnets—natural and artificial—poles of a magnet—lines of force—magnetic field—earth's magnetism.

Electricity and its various effects. Electric current—positive and negative terminals. Use of switches and fuses. Units of current, resistance and voltage. Ohm's law. Conductors and insulators. Unit of power—watt and kilowatt—relationship with horse power. Board of trade unit. Working of D. C. and A. C. Motors.

Use of tables and useful data in the shop.

Use of engineer's pocket hand book.

4. SOCIAL STUDIES.

- A. *History of Industrial Development in India—*
- (a) Agrarian nature of Indian Society till the end of the nineteenth century
 - (b) Establishment of industries particularly textile and steel up to the end of the first World War.
 - (c) Development of industry during the war period.
 - (d) Development during the Second World War.
 - (e) Industrial Development during the post-war period to-date.
- B. *Mineral and Natural Geography of India—*
- (a) Distribution of mineral resources e.g. iron, coal, manganese, petroleum etc.
 - (b) Distribution of natural resources e.g. cotton, jute, rubber, timber, tea, coffee and so on.
- C. *The establishment and development of industrial belts based on such factors as :—*
- (a) availability of mineral resources.
 - (b) availability of power resources (mainly hydro).
 - (c) availability of skilled manpower.
- D. *Social Hygiene—*
- (a) Different types of common diseases and their causes.
 - (b) Precautionary measures to be taken against diseases.
 - (c) Preventive measures—importance of personal and public hygiene.
 - (d) Elementary first-aid.
 - (e) Precautions against heat and sun stroke.
- E. *Fire Precautions—*
- (a) Causes and types of fire.
 - (b) Precautions against outbreak of fire.
 - (c) Fire extinguishers—types and uses.

F. *Indian Constitution.*—

- (a) Brief explanation of the Indian Constitution.
- (b) Political sub-division of India into States and Union Territories.
- (c) Brief description of Central, concurrent & State subjects.

G. *The three Five Year Plans with special reference to industrial development.*

Syllabi for Practical Training of Apprentices recommended by the Trade Committee for the following trades.

Group No. 2—

1. Pattern Maker.
2. Moulder.

The period of training for this group (to be called Foundry trade Group) will be 3 years consisting of basic training for a period of six months and shop training for the remaining period including allied trade training, if any, in respect of each trade.

1. **PATTERN MAKER.**

Basic Training 6 months (to consist of wood-work and metal work).

Wood-work—

Basic pattern making .. 3 months.

- (1) Use and maintenance of basic wood-working tools e.g. saws, chisels, files, planes, drills, drill bits and etc.
- (2) Reading of simple blue-prints of engineering drawings.
- (3) Use of steel rules, squares, scribes and dividers for marking out from drawings both in inches and millimeters.
- (4) Shaping of simple wooden objects to accuracy of $\pm 1/64$ " (or 0.5 mm.).
- (5) Use of different types of simple joints in pattern making.
- (6) Use of different types of jointing devices e.g. screws, nails, dowels, glue (organic and synthetic).
- (7) Use of different types of drill-bits used in wood-work including blind holes.
- (8) Use of contraction rule and making simple pattern and core-box.
- (9) Sharpening of chisels, planes etc. Sharpening and setting of hand-saws, tennon-saws, etc.

Metal work 1 month.

- (1) Use of steel rules, Engineers squares, scribes and dividers for marking out from drawings both in inches and millimeters.
- (2) Use of hack-saw, filing to line, centre-punch and different types of files.
- (3) Drilling and chain drilling.
- (4) Use of hammer and cold chisel. Grinding of cold chisels.
- (5) Use of inside, outside and double ended callipers. Use of odd leg callipers for centering.

Accuracy to be achieved at the end of the two months period $\pm 1/64$.

Moulding 2 months.

- (1) Use of different types of moulding and core sands, and moulding and core dressings.
- (2) Use of moulding tools, e.g. rammers, trowels, cleaners, smoothers, etc.
- (3) Simple core making.
- (4) Floor and/or box moulding, using two-part patterns.
- (5) Extraction of patterns.
- (6) Use of runners and risers.
- (7) Closing and pouring.

Remaining 2 years.

Shop Training.

Allied Trade Training.

Moulding 4 months.

- (1) Use of different types of moulding and core sands, moulding and core dressings as used in the establishment.
- (2) Use of moulding tools e.g. rammers, trowels, cleaners, smoothers etc.
- (3) Simple core making.
- (4) Floor and/or box moulding, using two-part patterns as available in the establishment.
- (5) Extraction of patterns.
- (6) Use of runners and risers.
- (7) Closing and pouring.
- (8) Use of metal plate moulding where available.
- (9) Inspection of castings.

Remainder period—

Essential—

- (1) Use of different types of woods and other available materials for pattern making.
- (2) Making intricate patterns, core-boxes, template etc. from blue-prints, as used in the establishment.
- (3) Use of wood-working machinery used for pattern making in the establishment.
- (4) Storage and preservation of patterns.
- (5) Making of patterns from sample objects.
- (6) Inspection of patterns.

Desirable—

- (1) Machine shop-Observing machining of castings on different types of machines.
- (2) Making master patterns.

2. MOULDER.

Basic training (6 months) only in his own trade either in a basic training shop or in an area of the foundry set aside for the purpose :—

- (1) Use of different types of moulding and core sands and moulding and core dressings as used in the establishment.
- (2) Use of moulding tools e.g. rammers, trowels, cleaners, smoothers etc.
- (3) Core making.
- (4) Floor and box moulding, using two-part patterns.
- (5) Extraction of patterns.
- (6) Use of runners and risers.
- (7) Closing and pouring.

Trade Training—

- | | | |
|-----------------------|----|------------|
| Allied Trade Training | .. | Essential. |
| Simple pattern making | .. | 2 months. |

Machine shop—

Desirable—

Observing machining of castings on different types of machines.

Moulding training for the remaining period .—

- (1) Making moulds and cores for a wider variety of castings.
- (2) Sand preparation and control.
- (3) Handling molten metal with safety precautions attached thereto.
- (4) Use of crucibles.
- (5) Fettleing and inspection of castings.
- (6) Core Making.
- (7) Use of chills.

Desirable—

- (1) Chill casting—Machine Moulding.
- (2) Charging, firing and tapping a cupola.

Proposed Syllabi for related Theoretical Instructions to the Apprentices recommended by the Trade Committee for the following trades.

Group No. 2—

1. Pattern Maker.
2. Moulder.

Period .. 3 years (6 hrs. per week for all subjects except social studies. 1 hr. per week for social studies.)

The subjects to be taught :—

- (1) Workshop Mathematic (for first two yrs. only).
- (2) Engineering Drawing (including geometrical drawing.)
- (3) Shop theory.
- (4) Social studies.

Minimum educational qualification Two classes below Matriculation or for eligibility. equivalent examination.

1. PATTERN MAKER.

(1) MATHEMATICS.

(A) For first six months—

Applied workshop problems involving multiplication and division. Common fractions—addition, subtraction, multiplication and division application of fractions to shop problems.

Decimals .. Addition, subtraction, multiplication. Conversion of decimals to common fractions. Reduction of common fraction to decimal fractions.

Square root .. The square root of a perfect square. The square root of a whole number and a decimal.

Percentage and its application. Problems.

Ratio/ and proportion. Problems.

Algebra .. Algebraic symbols, addition, subtraction, multiplication and division of expression involving algebraic symbols. Simple equation and transposition—problems. Standard algebraic formulae e.g. $(a+b)^2$ $(a-b)^2$, Simple simultaneous equations with two unknown quantities.

Mensuration .. Areas of rectangles, squares, triangles, circles and regular polygons. Calculation of area, volume and weight of simple solid bodies, such as cube, square and hexagonal prism problems.

Metric system .. Metric weights and measurements—units conversion factors problems.

(B) For the remaining period—

Geometry—

Properties of lines, angles, triangles and circles.

Logarithm—

Use of logarithm tables for multiplication and division.

Mensuration—

Area of circle and ellipse. Volume and weight of regular cone, sphere. Calculation of area, volume and weight of simple hollow solids applied problems.

Graphs—

Plotting of points, plotting and reading of simple graphs.

2. ENGINEERING DRAWING.

(A) For first six months—

Reading of simple blue-prints.

Free hand sketching—straight lines, rectangles, square, circles, polygon, etc. Free hand sketching of simple solids such as cube, rectangular block, cylinder and the views of these objects when looked perpendicular to its surfaces or axes.

Free hand sketching of nuts, bolts, rivets, washers, keys, screw threads, etc, with dimensions from samples.

Simple orthographic projection—1st angle and 3rd angle.

Views of simple hollow and solid bodies with dimension. Use of different types of lines and symbols for drawing.

Simple isometric drawing—*isometric* views of simple objects such as square, rectangles, cube, rectangular block, etc.

(B) For the remaining period—

Use of drawing instruments, T-square and drawing board. Construction of the simple figures and solids as mentioned above with dimensions and titles. Use of different types of scales in inches and millimeters.

Lettering numbers and alphabets.

Projection of straight lines in various positions. Projection of square, rectangles, circles and polygons. Projection of solid and hollow solids such as cone, prism, pyramid, etc. Views of simple solids cut by section plans. Development of surfaces of simple objects. Construction of different *isometric* scale.

Drawing of different types of joints used in wood work.

Free hand sketching of actual machine parts or engine parts such as bearings, pulleys, pistons, connecting rod, crank shafts, tail stock, tool post, engineer's vice, drill post—ratchet braces, etc.

Reading of intricate blue-prints.

Code of practice for general engineering drawings to be understood and followed as published by Indian Standard Institutions. (I. S. 696—1955).

3. SHOP THEORY.

(A) For first six months—

Safety precaution to be followed in the basic training centre.

Description of hand tools used in pattern making and moulding. Care and use of these tools. Description of Fitters tools in common use. Description of a ratchet brace and a bench grinder.

Names and uses of common ferrous and non-ferrous metals and their alloys, timbers and fuels.

Name and brief description of machines used in pattern making.

Mass—unit of mass. Force—the absolute unit of force. The weight of a body—unit of weight. C. G. S. and F. P. S. systems of unit.

Work—unit of work—energy—power—unit of power. Friction. Problems on straight and bell crank levers.

(B) For the remaining period —

Safety precautions to be followed in the shop.

Detailed description of hand cutting tools, their use and materials from which they are made of e.g. saw, plane, special plane, spokeshave gouges, boring tools and bits and etc.

Use and description of measuring tools, e.g. calipers of all types, verniers and etc.

Wood—different types, their properties and uses. Seasoning, storing and preservation of wood.

Brief description of the materials other than wood and metal used in pattern work, e.g. plaster of paris, wax, araldite, special resins and etc. and their properties and uses.

Brief manufacturing processes of pig iron, cast iron, wrought iron, steel and copper base alloys, bearing metals and etc.

Meaning of tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility.

Meaning of stress, strain, modulus of elasticity, ultimate strength, factor of safety and stresses of different types.

Heat and temperature. Thermometric scale—Fahrenheit and Centigrade. Conversion of Fahrenheit scale to Centigrade and *vice versa*.

Measurement of temperature—Name and brief description of the instruments used in the workshop including those for high temperatures, e.g. optical and immersion pyrometers.

Descriptive explanation of expansion of solids, liquids and gases due to heat—co-efficient of expansion.

Quantity of heat—unit of heat—B.Th. U; C.H.U., Calorie—specific heat of liquid and solid. Colorific value of different types of fuels.

Brief description of transference of heat—conduction, convection and radiation.

Brief description of hardening, tempering, annealing, normalising and case hardening.

Mechanical advantage—velocity ratio—useful work—mechanical efficiency of a machine.

Gear, belt and rope drive—determination of horse power, speed and size of pulleys and gears.

Machines—determination of velocity ratio, mechanical advantage and efficiency of winch, pulley blocks, wheel and compound axle.

Velocity and acceleration. Centre of gravity—demonstration of the determination of C.G. of simple bodies. Specific gravity. Determination of pressure at a point and surface under water or liquid.

Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackle. Calculation of force in the piston, ram and etc.

Machine tools—Description and use of Pattern Maker's wood lathe, universal saw bench, band saw, planer and jointer, Universal wood milling machine and etc. Routine lubrication and maintenance of these machines.

Patterns—types of patterns such as one piece pattern, split pattern, loose pieces, sweep patterns, skeleton patterns, mounted patterns and etc. an introduction to metal pattern making.

Allowance in construction of patterns—use of contraction rule.

Fastening process—gluing, clamping, screws, nails, dowels and etc.

Economic construction of large and intricate patterns. Numbering, storing and preservation of patterns. Painting of patterns according to I.S.I. standards. Finishing materials used in pattern work e.g. shellack etc.,

Use of tables and useful data in the shop. Use of pocket hand book.

4. SOCIAL STUDIES.

A. *History of Industrial Development in India—*

- (a) Agrarian nature of Indian Society till the end of the nineteenth century.
- (b) Establishment of industries particularly textile and steel up to the end of the 1st World War.
- (c) Development of industry during the—between—the—wars period.
- (d) Development during the Second World War.
- (e) Industrial Development during the post-war period to-date.

B. *Mineral and Natural Geography of India—*

- (a) Distribution of mineral resources e.g. iron, coal, manganese, petroleum, etc.
- (b) Distribution of natural resources e.g. cotton, jute, rubber, timber, tea, coffee and so on.

C. *The establishment and development of industrial belts based on such factors as—*

- (a) availability of mineral resources.
- (b) availability of power resources (mainly hydel).
- (c) availability of skilled manpower.

D. *Social Hygiene—*

- (a) Different types of common diseases and their causes.
- (b) Precautionary measures to be taken against diseases.
- (c) Preventive measures—importance of personal and public hygiene.

- (d) Elementary first-aid.
- (e) Precautions against heat and sun-stroke.

E. Fire precautions—

- (a) Causes and types of fire.
- (b) Precautions against out-break of fire.
- (c) Fire extinguishers—Types and uses.

F. Indian Constitution—

- (a) Brief explanation of the Indian Constitution.
- (b) Political sub-division of India into States and Union Territories.
- (c) Brief description of central, concurrent and State subjects.

G. The three Five-Year Plans with Special reference to industrial development.

2. MOULDER

(1) MATHEMATICS.

(a) For first six months—

As for Pattern Maker.

(b) For the remaining period—

Further problems on mensuration. Contraction and shrinkage—Change in volumes. Volumes and size of cupola and crucibles and ladles. Calculation of charge. Calculation of weights of castings. Simple calculation on work, power and energy.

(2) ENGINEERING DRAWING.

(For 2 years only)

(a) For the first six months—

As for Pattern Maker.

(b) For the remaining period—

Free hand sketching of simple machine parts and reading of engineering drawings.

(3) SHOP THEORY.

(a) For first six months—

Safety precaution.

Description of hand tools used in Moulding and Pattern Making. Care and use of these tools. Description of Fitters tools in common use.

Name and use of common ferrous and non-ferrous metals and their alloys, timbers and fuels.

Description of different types of moulding and core sands and dressing materials.

Mass—unit of mass. Force—the absolute unit of force. The weight of a body—unit of weight—C. G. S. and F. P. S. systems of units.

Work—unit of work—energy—power—unit of power.

Friction—Problems on straight and bell crank levers.

(B) For the remaining period—

Safety precaution to be followed in the shop.

Description of the following :—

Shrinkage of different metals.

Gating and feeding systems including use of chills.

Use of exo-thermic compounds.

Description of moulding equipment—sands, dressing materials, fire clay, clay wash, parting material, core-binders and etc.

Description of moulding process—green sand moulding, dry sand moulding and loam work. Selection of method.

Moulding irregular pattern.

Description of core making. Description of CO_2 process, shell moulding, cement moulding and thermit welding.

Materials—manufacturing process of pig iron, cast iron, malleable cast iron, plain carbon steel and alloy steel.

Description of blast furnace, cupola, converter, open hearth furnace and electric furnace.

Brief description of manufacturing process of non-ferrous alloys used in the foundry.

Meaning of tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility.

Meaning of stress, strain, modulus of elasticity, ultimate strength, factor of safety and stresses of different types.

Heat and temperature. Thermometric scale—Fahrenheit and Centigrade. Conversion of Fahrenheit scale to Centigrade and *vice versa*.

Measurement of temperature Name and brief description of the instruments used in the workshop including those for high temperatures, e.g., optical and immersion pyrometers.

Descriptive explanation of expansion of solids, liquids and gases due to heat—co-efficient of expansion.

Quantity of heat—unit of heat—B.Th.U; C.H.U., Calorie—specific heat of liquid and solid. Calorific value of different types of fuels.

Brief description of transference of heat—conduction, convection and radiation.

Heat treatment—Hardening, tempering, annealing, normalising and case hardening.

Description of properties and uses of moulding sand and refractories.
Properties and uses of foundry fuels and fluxes.

Testing of sands for permeability, green and dry sand compression and moisture. Testing for clay content, refractoriness and gradation of sand, etc.

Mechanical advantage—Velocity ratio—useful work—

Mechanical efficiency of a machine.

Gear, belt and rope drive—determination of horse power, speed and size of pulleys and gears. Machines—determination of velocity ratio mechanical advantage and efficiency of winch, pulley blocks, wheel and compound axle.

Velocity and acceleration. Centre of gravity demonstration of the determination of C. G. of simple bodies. Specific gravity. Determination of pressure at a point and surface under water or liquid.

Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackle. Calculation of force in the piston, ram and etc.

Description of common moulding machines, such as straight draw machine, turn over machine, hoppers and conveyors, machine for multiple moulds, core making machines, sand slingers, etc. Lubrication and routine maintenance of these machines.

Operation and management of cupola and crucible.

Method of transportation of molten metal—use of ladle and etc.

Cleaning of castings—sand, shot and hydro blasting, air-less shot blasting and tumbling barrels, brushes and dust arresters.

Fettling of casting. Use of hand and swing grinders.

Removal of excess metal and repair of casting by gas and arc cutting and welding.

Cast Iron composition—Influence of combined and free carbon influence of other elements, e.g., sulphur, silicon, phosphorous, etc. on cast iron. Alloy cast iron.

Chilled casting.

Steel Casting—

Influence of alloying elements. Non-ferrous casting—brass, bronze, white metal and aluminium alloy. Brief description of Centrifugal Casting and die Casting.

Testing of Casting—

Destructive and non-destructive Casting defects their causes and remedies. use of tables and useful data in the Shop. Use of pocket hand book.

(4) SOCIAL STUDIES.

Same as for Group No. 1.

**Syllabi for Practical Training of Apprentices recommended by the Trade
Committee for the following trades under Group No. 3.**

Group No. 3—

- (1) Blacksmith.
- (2) Sheet Metal Worker.
- (3) Welder (Gas and Electric).

The period of training for this group will be 3 years consisting of basic training for the period of six months and shop training for the remaining period including allied trade training if any in respect of each trade under the group. The syllabus for basic training of the trades under this group will be as follows :—

Basic Training—6 Months.

Metal work—

Safety precaution. Use of chisel, hammer, files for simple fitting work, simple forging and use of simple forge tools. Simple hardening and tempering of hand tools. Simple marking out from engineering drawings in inches and millimeters. Cutting of sheet metal to various sizes and preparation of simple sheet metal articles using simple hand tools. Soldering sheet metal joints. Brazing and welding of simple nature.

Shop training.

The syllabus for shop training will be as follows in respect of each of the trade under this Group after completion of basic training :—

1. BLACKSMITH.

Allied Trade Training—

Essential—

- (1) Welding (Gas and/or Elec.)—2 months.

Desirable—

- (1) Sheet Metal work : 1 month.
- (2) Fitting : 1 month.
- (3) Observation of machining operations, e.g., Lathe work and the like according to facilities available, preferably on forgings. : 1 month.

Remaining period in Blacksmithy—

- (1) Safety precautions.
- (2) Use of different types of hand tools used by blacksmithy.
- (3) Hand forging of different types of jobs as required in the establishment including smith welding.
- (4) General smithy operations, e.g., spreading, upsetting, drawing, shouldering, punching, drifting, cold and hot bending.
- (5) Hardening and tempering of simple cutting tools.

- (6) Grinding of forged articles where necessary.
- (7) Use of power hammer if available.
- (8) Use of smithy's rule and other gauges for manufacturing objects according to drawing giving necessary allowances for filing and or machining.
- (9) Use of different types of furnaces as available in the smithy shop of the establishment.

Should be able to manufacture articles by hand forging within an accuracy of $\pm 1/16''$ or 1.5. mm.

Desirable—

- (1) Use of dies for drop stamping and use of drop forges.
- (2) Use of forging machineries and presses as available in the establishment.
- (3) Repair, heat treatment and testing of chains.
- (4) Brazing of tipped tools.

2. SHEET METAL WORKER.

Essential—

Welding (Gas and/or Electric)—2 months.

Desirable—

- (1) Blacksmithy—1 month.
- (2) Fitting—1 month.
- (3) Observation of Machining operation, e.g., Lathe work and the like according to facilities available.—1 month.

Remaining period in Sheet Metal work—

- (1) Safety precautions.
- (2) Use of hand tools in Sheet Metal Work.
- (3) Use of sheet metal of different gauge sizes for beading, rolling, shaping, flanging, edging, hollowing and raising.
- (4) Use of ferrous and non-ferrous sheet metal.
- (5) Annealing of non-ferrous sheets, e.g. copper.
- (6) Making objects according to drawings in inches or mms. and/or samples involving development of patterns.
- (7) Use of hand operated machines for Sheet Metal Work.
- (8) Jointing of sheet metal by processes e.g., soldering, rivetting, brazing, etc.

Should be able to manufacture articles within an accuracy of $\pm 1/32''$ or 0.75 mm.

Desirable—

- (1) Use of power operated machines to work on sheet metal as available in the establishment.
- (2) Use of dies and setting machines for production work.

3. WELDING (GAS AND ELECTRIC)

Allied Trade Training—

Essential	..	<i>Nil.</i>	
<i>Desirable</i>	..	(1) Blacksmithy	1 month.
		(2) Sheet Metal work	.. 1 „
		(3) Fitting	1 „
		(4) Observation of machining operation.	1 „

Remaining period in Welding—

- (1) Safety precautions, and-use of safety devices for welding.
- (2) Simple method of avoiding distortion.
- (3) Weld sequence—direction of welding—back stepping—control of heat spread.
- (4) Use of chills, clamps, jigs and fixtures, etc.
- (5) Use of hand tools used in Gas welding.
- (6) Use of welding torch, acetylene generators and Oxygen cylinders.
- (7) Use of high pressure acetylene bottles.
- (8) Preparation and adjustment of surfaces for welding.
- (9) Use of appropriate sizes of light and heavy duty nozzles for welding and cutting.
- (10) Welding of objects according to drawing.
- (11) Use of hand tools used in Electric welding.
- (12) Electric welding of objects according to drawing.
- (13) Use of different types of electrodes and filler rods for welding.
- (14) Welding of different types of metals such as stainless steel, aluminium, cast iron etc. as carried out in the establishment.
- (15) Reclamation of worn parts by welding.
- (16) Heat treatment to welded jobs as necessary.
- (17) Inspection and testing of welds according to facilities available.

Desirable—

- (1) Use of different types of welding machines as available in the establishment.
- (2) Setting of welding machine for production work.
- (3) Use of profile cutting machines.

**Syllabi for Related Theoretical Instructions to the Apprentices
recommended by the Trade Committee for the following trades
under Group No. 3.**

<i>Group No. 3</i>	..	(1) Blacksmithy. (2) Sheet Metal Worker (3) Welder (Gas and Electric).
<i>Period</i>	..	3 years (6 hours per week for all subjects except Social Studies. 1 hour per week for Social Studies).

Minimum educational qualification for eligibility. Two standards below Matriculation or equivalent examination.

Subjects to be taught .. (1) Workshop Calculation.
 (2) Engineering Drawing (including geometrical drawing).
 (3) Trade theory.
 (4) Social Studies.

1. WORKSHOP CALCULATION.

(a) For first six months—

Applied problems involving multiplication and division. Common fractions—addition, subtraction, multiplication and division, application of fractions to shop problems.

Decimals .. Addition, subtraction, multiplication Conversion of decimals to common fractions. Reduction of common fractions to decimal fractions, Shop problems
 Metric system: Metric weights and measurements—units—conversion factors—problems.

Square root .. The square root of a perfect square. The square root of a whole number and a decimal.

Percentage and its application. Problems connected with the trade group.

Ratio and proportion .. Problems connected with the trade.

Algebra .. Algebraic symbols, addition, subtraction, multiplication and division of expression involving algebraic symbols. Simple equation and transposition—problems. Simple algebraic formulae viz., $(a + b)^2$, $(a - b)^2$, Simple simultaneous equations with two unknown quantities.

Mensuration .. Areas of rectangles, squares, triangles, circles and regular polygons. Calculation of area, volume and weight of simple solid bodies, such as cube, square and hexagonal prism problems.

Trigonometry .. Simple trigonometrical ratios—their relations and application to shop problems.

(b) For the remaining period—

Further problems on mensuration for the determination of volume and weight of metal required to forge different machinery components, size and area of sheet with necessary allowances for making various objects.

2. ENGINEERING DRAWING.

(a) For first six months—

Reading of simple blue-prints.

Free-hand sketching—straight lines, rectangles, squares, circles, polygon, etc.

Free-hand sketching of simple solids such as cube, rectangular block, cylinder and the views of these objects when seen perpendicular to its surfaces or axes.

Free-hand sketching of nuts, bolts, rivets, washers, keys, screw threads etc. with dimensions from samples.

Simple orthographic projection—1st angle.

Views of simple hollow and solid bodies with dimension—Use of different types of lines and symbols for drawing.

(b) For the remaining period—

Simple orthographic projection—3rd angle, Simple isometric drawing— isometric views of simple objects such as square, rectangles, cubes, rectangular blocks, etc.

Development of surfaces of simple objects. Curves of interpenetration— Simple exercises. Free-hand sketching of simple machine parts and production of working drawing.

3. TRADE THEORY.

(Common for the group for one year)

Safety precautions.—

Description of simple measuring tools and hand tools used in simple fitting operation, forge work, sheet metal work and simple welding operations. Care and maintenance of these tools.

Simple physical properties and uses of following—iron ore, pig iron, cast iron, wrought iron, mild steel, carbon steel, high speed steel, tin, copper, zinc, lead, aluminium, brass, solder and bearing metals.

Names and brief description of the common equipments necessary for sheet metal work, smithy and welding.

Mass and the weight of a body—unit of weight. C. G. S. and F. P. S. systems of units.

Work—unit of work—energy—power—unit of power, Friction.

Description of elementary lever systems.

Properties and uses of common fuels—coal, oil and gas.

Brief description of manufacturing processes of pig iron, cast iron, steel, copper and aluminium. Alloys and the influence of alloying elements.

Meaning of tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility.

Meaning of stress, strain, modulus of elasticity, ultimate strength, factor of safety and stresses of different types.

Heat and temperature. Thermometric scale—Fahrenheit and Centigrade. Conversion of Fahrenheit scale to Centigrade and *vice versa*. Measurement of temperature—name and brief description of the instruments used in the workshop including those for high temperatures, e.g., optical and immersion pyrometers. Descriptive explanation of expansion of solids, liquids and gases due to heat—coefficient of expansion.

Quantity of heat—unit of heat—B. Th. U. ; C.H.U., Calories—specific heat of liquid and solid. Calorific value of different types of fuels.

Brief description of transference of heat—conduction, convection and radiation.

Testing of materials—compressive test, tensile test, B. H. Test, shearing test and impact test.

Heat treatment—Hardening, tempering, annealing, normalising and case hardening.

Trade Theory—

For Blacksmith—(for remaining period)—

General safety precautions to be observed in the shop.

Description, use and care of the following—Mechanical hammers, power hammers, foot operated pneumatic hammer, hydraulic hammers, Drop forges and embossing. Commonly used refractory materials, properties and use. Construction of smithy furnaces. Forging process of light and heavy objects—upsetting, drawing down and setting down. Detection of defects in forging—Surface inspection, test by fracture and cutting.

Physical test and non-destructive test. Forging various tools and spares

Estimation of material and use of reference tables.

Centre of gravity—demonstration of the determination C. G. of simple bodies. Specific gravity.

Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackle.

For Sheet Metal Worker—(For the remaining period)—

Safety precautions to be observed in the shop.

Corrosion and its prevention by methods such as galvanising and electroplating etc. Different types and uses of joints used in sheet metal work. Development, layout and marking on sheet metals and formation of objects true to drawing such as steel cabinet, water tank, oil tank and etc.

Tubes—filling and bending of steel tubes, stainless tubes, copper tubes and making pipe coils.

Manufacture of articles made of copper, aluminium and alloy sheets.

Heat treatment of sheet metal.

Description of common machines used in sheet metal work such as shears, presses, automatic metal working machines and etc.

Description of hand operated machines used in the trade.

Commonly used refractory materials—properties and uses.

Centre of gravity—demonstration of the determination of C. G. of simple bodies. Specific gravity.

Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackle.

Estimation of material and use of reference tables.

Trade Theory—

For Welder—(Gas and Electric) for the remaining period—

Safety precautions to be observed in the Shop.

Melting points of metals, plasticity, ductility, malleability, hardness, brittleness etc. Combustion and oxidation of metals. Simple explanation of the change of structures of metals and stresses set up by welding.

Electricity—Elementary theory. Electrical units and electric circuit—relation of heat evolved with current and resistance circuit for arc welding. Control of voltage and current in relation to arc length, thickness of metal etc.

Description of electric welding plant—function, manipulation, care and maintenance of the plant. Different types of electrodes and fluxes. Slag control.

Different types of welding joints and necessary preparation required for these.

Properties and uses of acetylene and oxygen. Heat evolved in an acetylene flame. Description of high pressure and low pressure system of gas welding. Generation of acetylene. Advantages and disadvantages of dissolved and generated acetylene.

Description of the parts of gas welding plant and function, control and care of the plant.

Tools and accessories necessary for the plant.

- Regulators and blow pipes—high and low pressure blow pipes, various nozzles, their relation to the type of welding and thickness of metal.
- Welding rods and fluxes—welding rod for steel, cast iron, copper and its alloys, aluminium and its alloys. Common types of fluxes.
- Technique of and materials/fluxes used for low temperature welding and brazing of cast iron, and non-ferrous metals.
- Description and use of different types of flames—oxidising, reducing and neutral. Control of gas. Gas welding of different types of joints and preparation necessary for these.
- Flame cutting—hand and machine cutting process including use of propane.
- Speed of welding of different metals of different thickness by gas or electric welding.
- Importance of pre-heating. Description of pre-heating and stress relieving furnaces.
- Process of welding in different positions. Shrinkage and method of avoiding distortion.
- Defects in welds and prevention of defects. Testing of welds—destructive and non-destructive.
- Welding by electricity and gas—comparison.
- Description of common welding machines, e.g. seam welding, spot welding, butt welding, automatic arc welding machines etc.
- Use of jigs and fixtures.
- Principle of resistance welding.
- Heat treatment of welded objects—normalising, annealing, hardening, tempering, stress relieving etc.
- Repair work and reclamation of worn parts.
- Metal spraying.
- Argon welding.
- Centre of gravity—demonstration of the determination of C. G. of simple bodies. Specific gravity.
- Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackle.
- Estimation of materials and use of reference tables.

4. SOCIAL STUDIES.

History of Industrial Development in India—

- (a) Agrarian nature of Indian Society till the end of the nineteenth century.
- (b) Establishment of industries particularly textile and steel up to the end of the First World War.

- (c) Development of industry during the between—the wars period.
- (d) Development during the Second World War.
- (e) Industrial Development during the post-war period to-date.

Mineral and Natural Geography of India—

- (a) Distribution of mineral resources e.g. iron, coal, manganese, petroleum etc.
 - (b) Distribution of natural resources, e.g. cotton, jute, rubber, timber, tea, coffee and so on.
- C. *The establishment and development of industrial belts based on such factors as—*
- (a) Availability of mineral resources.
 - (b) Availability of power resources (mainly hydel).
 - (c) Availability of skilled manpower.
- D. *Social Hygiene—*
- (a) Different types of common diseases and their causes.
 - (b) Precautionary measures to be taken against diseases.
 - (c) Preventive measures—importance of personal and public hygiene.
 - (d) Elementary first-aid.
 - (e) Precautions against heat and sun stroke.
- E. *Fire Precautions—*
- (a) Causes and types of fire.
 - (b) Precautions against outbreak of fire.
 - (c) Fire extinguishers—types and uses.
- F. *Indian Constitution—*
- (a) Brief explanation of the Indian Constitution.
 - (b) Political sub-division of India into States and Union Territories.
 - (c) Brief description of Central, concurrent and State subjects.
- G. *The three Five-Year Plans with special reference to industrial development.—*

Syllabi for Practical Training of Apprentices recommended by the Trade Committee for the following Trades under Group No. 4.

Group No. —4

1. Electrician.
2. Lineman.
3. Wireman.

The period of training for this group will be 3 years consisting of basic training for the period of six months and shop training for the remaining period including allied trade training if any in respect of each trade under the group. The syllabus for basic training of the trades under this group will be as follows:—

Basic training—(6 months)—

- (1) Fitting—1 month.
- (2) Carpentry—1 month.
- (3) Sheet Metal Work—1 month.
- (4) Electrical work—3 months.

Fitting—

Use of fitting hand tools and simple fitting operations viz., chipping, filing, drilling, threading and fitting of bolts, nuts and screws.

Carpentry—

Use of basic carpenter hand tools for simple operations viz., chipping, planning, drilling and making simple joints. Use of nails, screws etc.

Sheet Metal Work—

Use of basic tools for cutting and forming sheet metal. Soldering joints. Simple forge work. Grinding of chisels and screw drivers etc.

Electrical work—

Use of basic hand tools of electrician. Use of single and multi-strand cables and wires for making joints. Use of electrical appliances, such as switches, plugs, cut-outs, regulators etc. Making simple electrical circuits on wooden boards. Use of primary and secondary batteries. Use of electrical meters. Verification of Ohm's Law.

Shop Training—

The syllabus for shop training will be as follows in respect of each of the trade under this group after completion of basic training :—

1. ELECTRICIAN.

Allied Trade Training—

*Essential—*Nil.

Desirable—

- (1) Turning—1 month.
- (2) Fitting—1 month.
- (3) Sheet Metal Work—1 month.
- (4) Carpentry—1 month.

If an establishment has facilities for less than the four types of work mentioned above, then the period relating to that type will be devoted to electrician work as mentioned below :—

Remaining period for Electrician—

Safety precaution including First-aid and artificial respiration.

Laying out wiring of all types of circuits commonly done in the establishment.

Use of common testing instruments such as ammeter, voltmeter, test lamp, megger etc., as available in the establishment.

Locating and rectifying faults in simple circuits.

Use, care, maintenance and charging of primary cells and secondary cells.

Running, care and maintenance of all types of DC and AC motors and starters.

Dismantling, cleaning, re-assembling and testing of ceiling and table fans with regulators.

Use of fuses, distribution and fuse boxes, different types of wires and cables, various types of switches and other fittings in common use.

Use, handling and testing of insulation materials.

Connecting up DC/AC meters and generators to starters, field regulators and switch board.

Cable jointing and termination.

Winding of low and medium voltage armatures, field coils and stators.

Industrial Switch board work.

Able to read circuit diagrams and work according to drawing either in inches or millimeters.

Desirable—

- (1) Routine maintenance of transformer.
- (2) Care, maintenance and repair of generators and alternators and testing them.

2. LINEMAN.

Allied Trade Training—

Essential—

Nil.

Desirable—

- (1) Blacksmith—1 month.
- (2) Carpentry—1 month.
- (3) Fitting—1 month.

Remaining period for Lineman—

Safety precaution including First aid and artificial respiration.

Use of Lineman's hand tools and other equipment such as ladder, pulley block and lifting tackles, draw vices etc.

Use of digging implements to dig holes and erecting poles, towers and fix stays.

Use of line materials such as insulators, cross arms, stay rods, wires and cables, earth plate, clamps, junction boxes, brackets, fuses, lightning arrester etc.

Scraping and painting of poles and towers.

Layout and stringing of overhead lines and low tension underground cables. Jointing of all types of wires and such cables.

Use of compression tools.

Detection of common line faults and their remedies.

Use of ammeters, voltmeters, meggers, insulator testers etc.

After the completion of training, the apprentice should be able to layout low tension as well as high tension overhead and low tension underground lines and work according to drawings either in inches or millimeters.

Desirable—

- (1) Use and maintenance of pole-type transformer tap changing gear.

3. WIREMAN.

Allied Trade Training—

Essential—

Nil.

Desirable—

- (1) Carpentry—1 month.
- (2) Fitting—1 month.

Remaining period for Wireman—

Safety precautions including First-aid and artificial respiration.

Use of wireman's hand tools and conduit dies and stocks. Care and maintenance of these tools.

Use of wiring materials for external and internal lighting, heating, power installation and earthing of different types.

Use of electric fittings and accessories for wiring such as switches, plugs, holders, brackets, cut outs, distribution board etc.

Wiring and use of power consuming devices such as fans, motors, lamps, heating stoves etc.

Different systems of wiring surface as well as concealed as done in the establishment.

Layout of circuits for lighting, heating and power installation etc.

Installation of meter boards.

Testing electrical installations and repairing common faults.

Able to read circuit diagrams and work according to drawings either in inches or millimeters.

Syllabi for related Theoretical Instructions to the Apprentices recommended by the Trade Committee for the following Trades under Group No. 4.

Group No. 4—

- (1) Electrician.
- (2) Lineman.
- (3) Wireman.

Period—

3 years (6 hrs. per week for all subjects except Social Studies. One hour per week for Social Studies).

*Minimum educational qualification for eligibility—**For Electrician—*

Must have passed Matriculation or equivalent examination.

*For Lineman and Wireman—**Essential—*

Two standards below Matriculation or equivalent examination.

Desirable—

A pass in Matriculation or equivalent examination.

The subjects to be taught—

- (1) Workshop Calculation : (for first two years only).
- (2) Engineering Drawing (including geometrical drawing—for first two years only).
- (3) Trade Theory.
- (4) Social studies.

(1) WORKSHOP CALCULATION (Common for the group).

(a) For first six months—

Applied workshop problems involving multiplication and division. Common fractions—addition, subtraction, multiplication and division, application of fractions to shop problems.

Decimals—

Addition, subtraction, multiplication, conversion of decimals to common fractions. Reduction of common fractions to decimal fractions. Problems.

Square-root—

The square root of a perfect square. The square root of a whole number and a decimal.

Percentage and its application—

Problems connected with the trade group.

Ratio and proportion—

Problems connected with the trade group.

Algebra—

Algebraic symbols, addition, subtraction, multiplication and division of expression involving algebraic symbols. Simple equation and transposition—problems Standard algebraic formulae. $g.(a+b)^2$, $(a-b)^2$. Simple simultaneous equation with two unknown quantities.

Mensuration—

Areas of rectangles, squares, triangles, circles and regular polygons. Calculation of area, volume and weight of simple solid bodies, such as cube, square and hexagonal prisma-problems.

Metric system—

Metric weights and measurements units conversion factors problems.

*(b) For the remaining period—**Geometry—*

Properties of lines, angles, triangles and circles.

Trigonometry—

Trigonometric functions. Use of trigonometrical tables. Applied problems principle of sine bar, calculation of areas of triangles, polygons etc.

Logarithm—

Use of logarithm tables for multiplication and division.

Mensuration—

Area of circle and ellipse. Volume and weight of regular cone, sphere. Calculation of area, volume and weight of simple hollow solids applied problems.

Graphs—

Plotting of points, plotting of graphs of simple equations, reading of graphs.

Further problems on mensuration. Determination of weight, diameter and length of different types of wires and cables. Calculation of requirements of materials for layouts of house wiring etc.

(2) ENGINEERING DRAWING (FOR TWO YEARS—COMMON FOR THE GROUP).

(A) For first six months—

Reading of simple blue-prints.

Free hand sketching—straight lines, rectangles, square, circles, polygon etc.

Free hand sketching of simple solids such as cube, rectangular block, cylinder and the views of these objects when looked perpendicular to its surfaces or axes.

Free hand sketching of nuts, bolts, rivets, washers, keys, screw threads etc. with dimensions from samples.

Simple orthographic projection—1st angle and 3rd angle.

Views of simple hollow and solid bodies with dimension—Use of different types of lines and symbols for drawing with special reference to electrical circuit diagrams.

Simple isometric drawing—*isometric* views of simple objects such as square rectangle, cube, rectangular block etc.

Free hand sketching of simple circuit diagrams.

(B) For the remaining period—

Use of drawing instruments, T-square and Drawing board. Construction of the simple figures and solids as mentioned above with dimensions and titles. Use of different types of scales in inches and millimeters. Lettering numbers and alphabets.

Projection of straight lines in various positions. Projection of square, rectangles, circles and polygons. Projection of solid and hollow solids such as cone, prism, pyramid etc. Views of simple solids cut by section plane. Development of surfaces of simple objects. Construction of isometric scale.

Drawing of sectional views of armatures, core, switches, bearings, stators etc.

Free hand sketching of actual parts of simple objects related to the trade group. Free hand sketching of electrical circuit diagrams using standard symbols. Reading of blue-prints of line and circuit diagrams.

(3) TRADE THEORY (COMMON FOR THE GROUP FOR FIRST ONE YEAR ONLY):

Safety precaution to be observed during basic training. Description of common hand tools used by Fitters, Carpenter, Sheet Metal Worker, Electrician, Lineman and Wireman.

Use, care and maintenance of these tools.

Name, use and properties of common engineering materials such as cast iron, steel, copper, timber and etc.

Magnets—natural and artificial—poles of a magnet—lines of force—magnetic field—earth's magnetism.

Electricity and its various effects. Electric current—positive and negative terminals. Use of switches and fuses. Units of current, resistance and voltage. Ohm's Law. Composition, properties and application of conducting and insulating materials. Unit of power—watt and kilowatt—relationship with horse power. Board of trade unit. Working of D. C. and A. C. motors.

Description of construction of primary cell and secondary cell.

Use of standard wire gauge and wire table.

Basic knowledge of generation, transmission and distribution of power. Description of electrical fittings and accessories such as different types of switches, plugs, holders.

Mass—unit of mass—force—the weight of a body—unit of weight C.G.S. and F.P.S. systems of units.

Work—unit of work—energy—power—unit of power. Friction. Simple problems on straight and bell crank levers.

Heat and temperature. Thermometric scales—Fahrenheit and Centigrade—conversion of Fahrenheit scale to Centigrade scale and *vice versa*. Measurement of temperature. Name and brief description of the temperature measuring instruments used in the workshop. Descriptive explanation of expansion of solids, liquids and gases due to heat—co-efficient of expansion. Brief description of transference of heat—conduction, convection and radiation.

Heat treatment: hardening, tempering, annealing, normalising and case hardening, simple heat treatment of copper and its alloys.

Meaning of tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility.

Meaning of stress, strain, modulus of elasticity, ultimate strength, factor of safety and different types of stresses.

Remaining period of two years—

For Electrician—

- Safety precautions to be observed in the shop.
- Knowledge of first-aid essential for an electrician.
- Magnetic effect, chemical effect and heating effect of electric current.
The practical application of these effects.
- Mechanical advantage—velocity ratio—useful work—mechanical efficiency of a machine.
- Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackles.
- Velocity and acceleration. Meaning of centre of gravity and specific gravity.
- Working principle of D. C. motors and generators. Description of construction of motors and generators.
- Armature—its construction, components and winding (lap and wave).
- Construction and functions of starters and regulators.
- Electrical circuits—light and power.
- Circuit diagrams—reading and drawing.
- Making out simple material specifications.
- Alternating current*—production of A. C.
- Description and definition of the values of alternating current and voltage.
- Power in A. C. circuit and power factor and its correction.
- Effects of inductance, resistance and capacitance in A. C. circuits and simple vector representation.
- Three phase supply.
- Arithmetical calculation of torque, speed and horse power of motors.
Use of simple electrical formulæ and making all ordinary D. C. electrical calculations and simple A. C. calculations.
- A. C. motors and generators—Description of the constructional features of common types motors and generators.
- Transformers—Principle of working of common types of transformers and description of their constructional features.
- Motor generating sets and conversion of A. C. to D. C. and *vice versa*.
- Description and application of rectifiers.
- Electrical measuring instruments—Description, working principles and construction of volt-meter, ammeter, energy meter, Megger, etc.
- Use, care and maintenance of these instruments.
- Description of the transmission of D. C. and A. C. supply system—high tension grid distribution.
- Electricity Act Rules.
- I. S. I. and Government specifications.

Use of tables and useful data in the shop.

Use of pocket hand-book.

Remaining period of two years—

For Lineman—

Safety precautions to be observed by lineman.

Knowledge of first-aid and safety equipment essential for a lineman.

Elementary electrical principles—Ohm's Law.

Uses of electricity for light, heat and power.

Composition, properties and application of common conductors and insulators.

Mechanical advantage—velocity ratio—useful work.

Mechanical advantage and efficiency of winch, pulley blocks, wheel and compound axle.

Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackles.

Meaning of centre of gravity and specific gravity.

Three phase connections—star and delta.

Three phase transmission lines.

Transmission lines—overhead and low tension underground cables.

Distribution system—feeders, distribution centres, primary mains, secondary mains and services.

Distribution circuits—Three phase three wire circuits—three phase four wire circuits—single phase two wire circuits—single phase three wire circuits. Direct current two and three wire circuits. Construction of overhead and underground net-works.

Poles, wooden, steel and concrete.

Tower : rigid and flexible. Cross arms : types and sizes. Pole hardware : braces, bolts and lag screws, pole guys, anchors, pole steps. Insulators : different types such as pin, suspension and strain.

Line conductors : copper, aluminium steel and copper-clad steel, classes of conductors, conductor insulation, wire sizes and standard wire gauge.

Low tension pot head : use and construction.

Pole-type distribution Transformers : purpose, principle of operation, standard sizes, types, transformer connections, polarity, grounding of transformer.

Feeder voltage regulator : purpose, connections, tap changer or step regulator.

Current and potential transformers : purpose, connections and use.

Ground wire and lightning arresters of different types.

Switches and isolators.

Fuses : Purpose and principle of operations and different types of fuses such as plug type fuse, primary cut out, automatic cut out, cartridge fuse, expulsion fuse, liquid fuse, etc.

Conductor arrangement, span, ground clearance, wire crossing, clearance, sag, sag tables, pole or tower height, etc.

Locating and staking lines.

Unloading, framing and hauling poles.

Erecting and setting poles—digging pole holes and method of erecting and setting poles and the common equipments necessary for these purposes. Guying poles—guy construction.

Mounting cross arms, pins, insulators, etc.

Joining, stringing and sagging conductors and the equipment necessary for these.

Installing pole transformers, lightning arrester, switches and isolators.

Stringing secondary mains.

Installing services : Installing service brackets, testing of phases and connecting service leads to secondary mains.

Tower and tower line erection—foundation and sequence of erection.

Patrolling and inspecting lines.

Line testing—Kinds of circuit faults, testing ground resistance, field testing of line insulators.

Maintenance of live lines and tools necessary for that. Brief description of method of electrification of rural and urban areas.

Electricity rules—I. S. I. and Government specification.

Use of relevant tables and data.

Use of pocket hand book.

Remaining period of two years—

For Wireman—

Safety precaution to be observed by wireman.

Knowledge of first-aid essential for a wireman.

Ohm's Law—series and parallel circuit.

Magnetism—magnetic effects—self-induction.

Primary and secondary batteries.

Elementary principles of parallelogram and triangle of forces. Demonstration of lifting tackles.

Velocity and acceleration. Meaning of Centre of gravity and specific gravity.

Electromagnetic action. Generation of D. C. and A. C. Comparison between A. C. and D. C. Motors and generators. Transformers—use and types.

General supply and distribution systems high and low tension supplies.

- Wiring systems (hazardous and non-hazardous) and circuits—conduits and cables (including PVC & MIC), general layout, arrangement of circuits, position of fuse, loading of cables, looping in wiring system, joint boxes, multipoint switching, heating circuits, earth connections, earth test.
- Standard specification for wiring.
- Name, use and care of wireman's tools.
- Marking out positions, method of fixing conduits, capacities of conduit, tube cutting, loop-in connections, concealed wiring, lead-covered wiring, soldering and brazing.
- Temporary wiring for construction work and festive occasions.
- Rising mains, floor wiring, roof wiring, drawing in cables, etc.
- Different types of switches and switch gear.
- Ceiling roses, fixing blocks, holders, plugs, radiator switches, main switches, cooker control panels, power circuit switches, thermostats, mercury switches and motor starters.
- Lighting work—checking illumination—incandescent lamps, gas-filled lamps, mercury and sodium discharge tubes, fluorescent tubes and knowledge of safety precaution.
- Lighting regulators (dimmers) types of reflector fittings. Mounting heights, Factory lighting, Domestic and commercial illuminations. Architectural lighting.
- Wiring domestic apparatus—electric fires, air circulators, cookers, water-heater, automatic water boiler, bells and signalling equipment, indicators, burglar alarms, electrically controlled clocks, extension loud speakers, refrigerators, Air-conditioners, etc.
- Wiring industrial apparatus—Low voltage transformers, voltage adjustment, using various D. C. machines, motor starters, A. C. generators and motors, voltage control, induction motors, star-delta and auto transformer starting, liquid starters, bus-bar system, electric welding apparatus, electroplating, industrial telephones, ventilating system, battery charging and etc.
- Use of measuring instruments—Voltmeter, ammeter, wattmeters, energy meters, test lamps and etc. Testing and fault location—method of testing and testing equipment.
- Repair work—jointing conductors, chasing for conduits, making good in plaster, plugging walls, fixing pendants, heating and lighting sockets, rewiring industrial installations, Routine maintenance of A. C and D. C. Motors.
- Electricity rules. I. S. I. and Government specification.
- Use of tables and data.
- Use of pocket hand book.

(4). SOCIAL STUDIES.

A. *History of Industrial Development in India—*

- (a) Agrarian nature of Indian Society till the end of the nineteenth-century.
- (b) Establishment of industries particularly textile and steel up to the end of the First World War.
- (c) Development of industry during the—between the wars period.
- (d) Development during the Second World War.
- (e) Industrial Development during the post-war period to-date.

B. *Mineral and Natural Geography of India—*

- (a) Distribution of mineral resources, e.g., iron, coal, manganese, petroleum, etc.
- (b) Distribution of natural resources, e.g., cotton, jute, rubber, timber, tea, coffee and so on.

C. *The establishment and development of industrial belts based on such factors, as—*

- (a) Availability of mineral resources.
- (b) Availability of power resources (mainly hydel).
- (c) Availability of skilled manpower.

D. *Social Hygiene—*

- (a) Different types of common diseases and their causes.
- (b) Precautionary measures to be taken against diseases.
- (c) Preventive measures—importance of personal and public hygiene.
- (d) Elementary first-aid.
- (e) Precautions against heat and sun stroke.

E. *Fire Precautions—*

- (a) Causes and types of fire.
- (b) Precautions against outbreak of fire.
- (c) Fire extinguishers—Types and uses.

F. *Indian Constitution—*

- (a) Brief explanation of the Indian Constitution.
- (b) Political sub-division of India into States and Union Territories.
- (c) Brief description of Central, Concurrent and State subjects.

G. *The three Five-Year Plans with special reference to industrial development.*

Syllabi for Practical Training of Apprentices recommended by the Trade Committee for the following Trade under Group No. 5.

Group No. 5—

1. Carpenter.

The period of training for this group will be 3 years consisting of basic training for a period of six months and trade training for the remaining period including allied trade training if any in respect of each trade under the group. The syllabus for basic training of the trade under this group will be as follows :—

Basic training (6 months)—

- (1) Carpentry—4 months.
- (2) Metal work—2 months.

Carpentry—4 months—

- (1) Use, care and maintenance of basic wood working tools (as supplied in basic training workshop) including sharpening of chisels and plane blades.
- (2) Reading, and working from, simple drawings and blue-prints, in English and Metric system.
- (3) Preparation of rough timber to finished sizes using jack plane, try-square, rule and marking gauge.
- (4) Marking out and making the following simple joints using additional tools such as marking knife, mortice gauge, tenon and dovetail saws, firmer, and mortice chisels ;
 Half-lap joints—angle and tee ;
 Housing joints ;
 Bridle joints—angle and tee ;
 Mortice and tenon joints—tee, barefaced and haunched.
 Dovetail joints—half-lap, through and lap.
- (5) Marking out and making more difficult joints such as :—
 Tusk-tenon joint ;
 Bridle joints—oblique ;
 Mortice and tenon joints—oblique ;
 Wedged and scarfed joints ;
 Rubbed, glued and slot-screwed joints.
- (6) Manufacture of simple articles involving the use of joints, screws, nails, dowels and glues (organic and synthetic) and the fitting of hinges, locks and handles. These may include trays, stools, bookshelves, cabinets (including simple doors and drawers), straight edges, plumb rules, carpenters sawing stool, trestles, etc.
- (7) Sharpening and setting of saws, using precision saw set.

Metal work—2 months—

- (1) Marking out using steel rules, squares and scribes.
Use of dividers and compasses for marking out to drawings using both inches and metric system.
- (2) Use of hack-saw, centre-punch and different types of files.
- (3) Drilling and chain drilling.
- (4) Use of hammer and cold chisel. Grinding of cold chisels.
- (5) Use of inside and outside callipers and verniers. Use of odd leg callipers.

*Trade Training.**Allied Trade Training—**Desirable—*

- (1) Wood finishing (filling, varnishing, polishing, painting, etc.)—1 month.
- (2) Blacksmithy and Sheet Metal work—1 month.
- (3) General building trades—2 months.

Note.—The general building trades work should be an introduction to the trades of mason, brick-layer, plasterer, floor layer, concreter, wireman, painter and decorator, glazier, etc. The objective is not to train the apprentice in these trades, but to show him the interdependence of his own trade with the other building trades and the difficulties which may be experienced by any one of the building trade workers if other tradesmen produce poor quality work. Work and/or experience at the building sites is recommended and may cover such items as laying screeds for flooring and assisting in laying floors, setting door and window frames in position and assisting mason, brick-layer or concreter to build in, fixing door and window frames in existing masonry, brick work or concrete, preparing and fixing shuttering (formwork), setting out of buildings including use of "3, 4, 5" and "timber-square" methods for obtaining right angles, erection and marking of profiles, making and fixing switch boards and other wireman's materials.

Remaining period in Carpentry—

- (1) Use, care and maintenance of additional wood workers hand tools including portable powered hand tools.
- (2) Reading and working from more complicated drawings and blue-prints including simple architectural drawings;
- (3) Introduction to available wood working machinery including circular saw, surfacer, planer and thicknesser, morticing (chain and chisel) and tenoning machines, band and fret saws, spindle, sander and wood turning lathe and safety precautions relating thereto.
- (4) Use of joiner's 'rod

- (5) Setting out and making door and window frames, doors and sashes (by hand and/or by use of machinery) as under :—
 Doors—battened, ledged and braced ; framed and panelled (including glass panels) flush.
 Casements—side, top and bottom hung.
- (6) Fixing and hanging doors and windows including fitting of furniture, i.e. stays, locks, fasteners, handles, etc.
- (7) Manufacture of articles such as cupboards, tables, stools, doors, book cases, desks, etc. (including the use of plywood and other fabricated boards).
- (8) Construction of shuttering (formwork) for—
 (a) straight walls ; simple lintels, heads, cills, floors, flat roofs, etc.
 (b) quoins and door and window reveals ; square and splayed foundations ; more difficult lintels, cills, etc. square, tapered and round columns ; beams ; arches (including construction of centres) and bay windows ; stairs.

Note.—In districts where flat roofs are in normal use, this item may have to be restricted to simple models together with theoretical study.

- (9) Construction of partitions, louvres, sky and lantern roof lights.

Desirable—

- (1) Seasoning, storage and preservation of different types of timbers.
 (2) Construction of single, double and framed roofs including construction of common form(s) of roof truss, e.g., king post, queen post, belfast, etc.
 (3) Making and erecting temporary or permanent framed wooden buildings.

Syllabi for Related Theoretical Instructions to the Apprentices recommended by the Trade Committee for the following trade under Group No. 5.

Group No. 5—

- (1) Carpenter.

Period.—3 years (6 hrs. per week for all subjects except social studies. One hour per week for social studies).

Minimum educational qualification for eligibility.—Two standards below Matriculation or equivalent examination.

The subjects to be taught.—

- (1) Workshop calculation.
 (2) Engineering drawing.
 (3) Trade theory.
 (4) Social studies.

(1) WORKSHOP CALCULATION.

(a) For first six months—

Applied workshop problems involving multiplication and division. Common fractions—addition, subtraction, multiplication and division, application of fractions to shop problems.

Decimals—

Addition, subtraction, multiplication. Conversion of decimals to common fractions. Reduction of common fractions to decimal fractions. Shop problems.

Metric system—

Metric weights and measurements—units—conversion factors—problems.

Square root—

The square root of a perfect square.

The square root of a whole number and a decimal.

Percentage and its application—

Problems connected with the trade group.

Ratio and proportion—

Problems connected with the trade.

Algebra—

Algebraic symbols, addition, subtraction, multiplication and division of expression involving algebraic symbols.

Simple equation and transposition problems. Simple algebraic formulae viz. $(a+b)^2$, $(a-b)^2$, Simple simultaneous equations with two unknown quantities.

Mensuration—

Areas of rectangles, squares, triangles, circles and regular polygons.

Calculation of area, volume and weight of simple solid bodies, such as cube, square and hexagonal prism—problems.

Trigonometry.—

Simple trigonometrical ratios—their relations and application to shop problems.

(b) For the remaining period—

Further problems on mensuration. Determination by calculating the size, quantity and weight of timbers necessary for various types of wood work. Preparation of estimates.

(2) ENGINEERING DRAWING.

For first six months—

Reading of simple blue-prints.

Free hand sketching—straight lines, rectangles, squares, circles, polygon etc.

Free hand sketching of simple solids such as cube, rectangular block cylinder and the views of these objects when looked perpendicular to its surfaces or axes.

Free hand sketching of nuts, bolts, rivets, washers, keys, screw threads etc. with dimensions from samples.

Simple orthographic projection—1st angle.

Views of simple hollow and solid bodies with dimension.

Use of different types of lines and symbols for drawing.

(b) *For the remaining period—*

Simple orthographic projection 3rd angle. Simple isometric drawing— isometric views of simple objects such as square rectangles, cube, rectangular block etc.

Free hand sketching of nuts, bolts, screws, brackets, hinges and etc. Isometric drawing of simple objects such as Table, door, rack and etc.

Free hand sketching and production of working drawing of trusses, furniture and other constructional details of wood work.

(3) TRADE THEORY.

(a) *For first six months—*

Safety precaution to be observed in basic training. Description, use and care of fitters hand tools. Description, use and care of carpenters and joiners hand tools.

Properties and uses of common engineering materials. Hardening and tempering of chisels and method of grinding chisels and sharpening tools including explanation of correct angles, and methods used in grinding, sharpening and setting of chisels, plane blades and saws.

Description of common wood working joints—those included in practical syllabus.

Description and use of fixing materials (nails, screws, glues, etc.) and door and window furniture (hinges, fastenings, locks, stays, handles etc.).

Mass and the weight of a body—unit of weight. C. G. S. and F. P. S. system of units.

Work—unit of work—energy—power—unit of power.

Friction—Description of elementary lever systems.

(b) *For the remaining period—*

Safety precautions to be observed in the shop particularly in the u. wood-working machineries.

Timbers—

Different varieties, properties and their uses. Seasoning of timbers, shrinkage of timbers. Diseases and defects of timber. Preservation of timber. Market forms of timber.

Description and use of veneer, plywood and other types of fabricated boards.

Heat and temperature. Thermometric scales—Fahrenheit and centigrade conversion of Fahrenheit scale to Centigrade scale and *vice versa*. Measurement of temperature. Name and brief description of the instruments e.g. Thermometers, hygrometers, barometers, etc. used in the workshops. Descriptive explanation of the expansion of solids, liquids and gases due to heat—co-efficient of expansion. Brief description of transference of heat—conduction, convection and radiation.

Heat treatment—hardening, tempering, annealing, normalising and case-hardening. Heat treatment of wood-cutting tools.

Elementary principles of parallelogram and triangle of forces.

Demonstration of lifting tackles.

Meaning of Centre of gravity and specific gravity.

Selection of timbers for different types of jobs.

Description and use of common wood working machineries.

Uses of all types of joints in constructional work.

Description of and method of using joiner's 'rod'.

Use of portable powered hand tools.

Construction details for door and window frames, doors, casements, partitions, louvres, sky and lantern lights, framed wooden buildings.

Roofing principles—single, double and framed roofs, including common forms of truss.

Shuttering (formwork)—description of various uses of shuttering, method of construction, fixing and removal for re-use.

Different types and uses of pre-fabricated materials.

Estimation of materials and use of reference tables.

(4) SOCIAL STUDIES.

(Same as for group Nos. 1, 2, 3 and 5.)

Obtainable from the Maharashtra Government Publications, Sales Branch, Majestic Hotel, Opp. Regal Cinema, Colaba Causeway, Bombay-1 (Sale on Counter only); from the Government Book Depot, Charni Road Gardens, Bombay 4 (for orders from the mofussil) or through the High Commissioner for India, India House, Aldwych, London, W.C.2 or through any recognised Bookseller.