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DEPARTMENT OF LABOUR

REPORT
OF THE
ADVISORY COMMITTEE
ON
TECHNICAL TRAINING
1944-45

Training and Apprenticeship of Craftsmen for Industry

PART- II

Syllabuses of Training



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INTRODUCTION.

Part II of the Report of the Advisory Committee on Technical Training contains the syllabuses to be followed at the training centre. The course at the training centre will consist of two parts—

- (1) basic training (6 months), and
- (2) trade training (18 months).

The object of the basic training is to give the craftsmen some knowledge of the work carried out by tradesmen belonging to allied trades. After completion of the basic training, the candidate will be trade tested and if he has reached the required standard, he will begin the second part of his training, *viz.*, training in the selected trade.

2. For the purpose of basic training, trades have been divided into what are called foundation groups, as follows :—

Group I.—Blacksmiths, Boiler Makers, Die Sinkers, Draughtsmen (Mechanical) Electricians, Electroplaters, Engine Artificers, Fitters, Instrument Mechanics, Machinists, Motor Mechanics, Moulders, Plumbers, Tin & Copper-smiths, Shipwrights, Turners, Welders (Electric and Oxy-acetylene) and Wireless Mechanics.

Foundation Trade—Fitting.

Group II.—Bricklayers and Masons, Carpenters and Joiners, Painters and Decorators, Pattern Makers, and Textile Refitters.

Foundation Trade—Carpentry.

3. On entering a training centre, the candidate will be given 4 months training at the foundation trade of the group to which his trade belongs, and then one month at the foundation trade of the other group. In addition, all candidates will work for one month at forging and sheet metal work. The three periods together will constitute the basic training period.

4. It is recommended that, whenever possible, use should be made of cinema films for instructional purposes, and training centres should be supplied with projectors.

5. Biased instruction in accordance with the wishes of prospective employers should be given at the training centre as far as possible.

6. The syllabuses are based on the experience of technical training gained during war-time and incorporate the suggestions made by employers all over the country. They will, however, need modification from time to time in the light of further experience. Syllabuses for other trades in which it is subsequently found necessary to impart training will have to be prepared as required.

I.—BASIC TRAINING.

General Theoretical Subjects.

1. *Arithmetic*.—(To be followed throughout Basic Course).

Reading and writing of English figures. Addition, Subtraction, Multiplication and Division of Fractions and Decimals and their mutual conversion. Simple calculations involving areas, volumes, weights measures and ratio and proportion.

2. *Drawing*.—(To be followed throughout Basic Course).

Mechanical.—Freehand drawing and dimensioning of Elevation, Plan and End views of geometrically shaped objects, including sectional views. Conventional drawing of different forms of screw threads—bolts, nuts and studs. Blue-print reading.

Geometrical.—Drawing parallels. Erecting perpendiculars. Constructing angles, triangles and squares. Dividing straight lines into any given number of equal parts. Bisecting angles. Drawing circles touching each other, circumscribed and inscribed in squares and triangles.

Basic Training Course for Group I.

(Duration of course 6 months).

1. *Fitting* 4 months.

Theoretical—(12 hours per week. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively.)

(a) Arithmetic.

(b) Drawing.

(c) Safety precautions and elementary first aid.

(d) Metals and Alloys—simple physical properties and uses of the following :—

Iron ore, Pig iron, Cast iron, Wrought iron, Mild steel, Carbon steels, High speed steel, Tin, Copper, Zinc, Lead, Aluminium, Brass, Bronze, Solder and Bearing metals.

(e) Measuring Tools—The Rule, how marked and used. Callipers (outside and inside), setting and use.

(f) All common hand tools used in Fitter's trade :—

(i) their names, description, materials from which made and uses ;

(ii) care and maintenance of tools (to be given special attention).

Practical—(24 hours per week).

(a) Marking off.

(b) Chipping flat surfaces and key ways.

(c) Filing flat, angular and curved surfaces.

(d) Hacksawing.

(e) Drilling.

(f) Tapping and thread cutting.

2. *Carpentry* 1 month.

Theoretical—(12 hours per week. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

(a) All common hand tools used in Carpentry :—

(i) their names, description, materials from which made and uses ;

(ii) care and maintenance of tools (to be given special attention).

(b) Common types of wood, their description and uses.

Practical—(24 hours per week).

- (a) Sawing.
- (b) Planing.
- (c) Making simple joints including Mitre and Mortise and Tenon.

3. *Forging and Sheet Metal Work* 1 month.

Theoretical—(12 hours per week. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

- (a) Blacksmith's forge, anvil and all common hand tools :—
 - (i) their names description, materials from which made and uses ;
 - (ii) care and maintenance of tools (to be given special attention).
- (b) Tinsmith's common hand tools :—
 - (i) their names, description, materials from which made and uses ;
 - (ii) care and maintenance of tools (to be given special attention).

Practical—(24 hours per week).

- (a) The forge, management of the fire, how prepared, size required, control of draught, etc.
- (b) Simple drawing and upsetting.
- (c) Cutting sheet metal to different shapes.
- (d) Making common sheet metal joints.
- (e) Wiring and soldering.

Basic Training Course for Group II.

(Duration of course 6 months).

1. *Carpentry* 4 months.

Theoretical—(12 hours per week. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

- (a) Arithmetic.
- (b) Drawing.
- (c) Safety precautions and elementary first aid.
- (d) Common types of wood, their description, properties, uses and common defects.
- (e) Metals and Alloys—simple physical properties and uses of the following :—

Cast iron, Mild steel, Carbon steel, Tin, Zinc and Brass.

- (f) Measuring Tools—The Rule, how marked and used. Marking gauge, setting and use.

- (g) All common hand tools, used in Carpentry :—
 - (i) their names, description, materials from which made and uses ;
 - (ii) care and maintenance of tools (to be given special attention).

Practical—(24 hours per week).

- (a) Sawing—along and across the grain.
- (b) Planing.
- (c) Making simple joints, such as, Halved joints, Common Mortise and Tenon, Stub Tenon, Tohle joint, etc.

2. *Fitting* 1 month.

Theoretical—(12 hours per week. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

- (a) All common hand tools used in Fitter's trade :—
- (i) their names, description, materials made from and uses ;
 - (ii) care and maintenance of tools (to be given special attention).

Practical—(24 hours per week):

- (a) Marking off.
- (b) Chipping.
- (c) Filing.
- (d) Hacksawing.

3. *Forging and Sheet Metal Work* 1 month.

Theoretical—(12 hours per week. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

- (a) Blacksmith's forge, anvil and all common hand tools :—
 - (i) their names, description materials made from and uses ;
 - (ii) care and maintenance of tools (to be given special attention).
- (b) Tinsmith's common hand tools :—
 - (i) their names, description, materials from which made and uses ;
 - (ii) care and maintenance of tools (to be given special attention).

Practical—(24 hours per week).

- (a) The forge, management of fire, how prepared, size required, control of draught, etc.
- (b) Simple drawing and upsetting.
- (c) Cutting sheet metal to different shapes.
- (d) Making common sheet metal joints.
- (e) Wiring and soldering.

II.—TRADE TRAINING.

NOTE.—Along with the training in any trade, instructions, will be given in certain general theoretical subjects as described below. Reference to these subjects is made in the syllabuses for each individual trade.

1. *Mathematics.*—Recapitulation and problems in connection with work carried out during the Basic Training Course. Instruction in Metric System, Roots, Powers, etc.

2. *Drawing.*—Geometrical methods of setting out templates and patterns. Riveted joints, Different forms of screw threads (Whitworth, Square and Buttress), separate and complete assembled drawings (with sectional views) of simple machine and engine parts, such as, Stuffing Boxes, Glands, Shaft Couplings, Bearings, etc.

3. *Metals and Alloys.*—Composition, detailed characteristics (relative weights, physical and mechanical properties) and uses of Pig Iron, Cast Iron, Wrought Iron, Mild Steel, various grades of Carbon Steel, Alloy Steels, Copper, Zinc, Tin, Lead, Aluminium, Platinum, Brass, Bronze, Bearing metals and Solids.

1. *Blacksmiths.*

(18 months' course after completing Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. General Theory.—

- (a) Mathematics }
 (b) Drawing } As laid down on page 3.

2. Related Theory.—

- (a) Object of the trade.
 (b) Metals and alloys, as laid down on page 3 with special reference to ferrous metals.
 (c) All blacksmiths' hand tools—detailed description use and special attention necessary for their maintenance.
 (d) Forge—construction, use and maintenance.
 (e) Blowers—description of common types of blowers and fans, their working principles, connections, control of air blast. Hand bellows—comparison with blowers and disadvantages.
 (f) Fuels—different kinds and their respective uses.
 (g) Fires—lighting and management. Effect of blast, types and sizes of fire, dirty fires.
 (h) Smithing operations—meaning and detailed description of all operations.
 (i) Effects of heat on metals. Forging, welding and finishing heats. Defects due to working at improper heats.
 (j) Heat treatment of metals—normalising, annealing, hardening and tempering. Types of furnaces used for heat treatment.
 (k) Temperatures and connected colours.
 (l) Calculation of material for various smithing operations.
 (m) Power hammers—description, working principles and uses.
 (n) Principles of brazing, gas and arc welding—equipments, their manipulation and care.
 (o) Safety precautions.

Practical.—(28 hours per week throughout the course).

1. Smithing operations.—

- (a) Lighting and management of fire.
 (b) Drawing, upsetting, cutting, bending, punching and drifting.
 (c) Riveting and use of dollys.
 (d) Shrink fitting.
 (e) All types of welds.
 (f) Manufacture of tools.
 (g) Bending angle iron and Tee sections, use of bending bars.
 (h) Forging tool steel annealing, hardening and tempering.
 (i) Manufacture and tempering of springs.
 (j) Heavy forging, including use of power hammer.
- 2. Extra curriculum work—short course on—**
 (a) Brazing.
 (b) Gas and arc welding.

2. Boiler Makers.

(18 months' course after completion of Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. General Theory.—

- (a) Mathematics }
 (b) Drawing } As laid down on page 3.

2. Related Theory.—

- (a) Object of the trade.
- (b) Metals and alloys—as laid down on page 3.
- (c) All tools common to the trade—detailed description, use and special attention necessary for their care and maintenance.
- (d) Hydraulic and pneumatic tools—description, manipulation and care.
- (e) Working principles of boilers—smoke and water tube types. Description and construction of common types of boilers.
- (f) Boiler mountings—valves, gauges, etc., construction and uses.
- (g) Working principles of Superheaters and Economisers.
- (h) Safety and frost precautions.
- (i) Different types of rivets and rivet heads. Description of the different forms of riveted joints—Lap and Butt (single and multi-riveted). Simple calculations relating to riveted joints and rivet lengths. Description and processes of cold, hot, hydraulic and pneumatic riveting. Methods of detection of faulty rivets.
- (j) Methods of bending and straightening plates.
- (k) Methods of cleaning boilers. Nature of deterioration in different types of boilers.
- (l) Processes of removing, replacing and expanding tubes. Methods of removing, making and inserting various boiler stays.
- (m) Joints and methods of jointing pipes. Use of jointing materials, such as, asbestos, red lead, etc.
- (n) Heat treatment—annealing hardening and tempering. Furnaces for heat treatment.
- (o) Principles of gas and arc welding. Description and manipulation of plant and tools.
- (p) Methods of testing boilers.
- (q) Safety precautions.

Practical.—(28 hours per week throughout the course).

1. Making rivets.
2. Making riveted joints (cold and hot riveting hand and machine riveting)—Lap and Butt—involving annealing, marking, punching, drilling, riveting, caulking, fullering, etc.
3. Testing for faulty rivets. Extracting faulty rivets and broken studs and replacing by new ones.
4. Making tools—drifts, chisels, snaps, caulking tools, including necessary heat treatment.
5. Straightening and bending plates and angle irons.
6. Construction of chimneys, ash pans, manhole covers, flanges, etc.
7. Welding by arc and/or Oxy-acetylene processes. Flame cutting. Building up or thickening of plates.
8. Cleaning of boilers—washing out removal of scales.
9. Use of ratchet brace and drills in congested places.
10. Use of tube expander and removal and fitting of boiler tubes.
11. Removal of tube plates and fixing new ones. Fixing patches on shells, fire boxes, tube plates, etc.
12. Removing and inserting stays.
13. Fitting up of boiler mountings.
14. Jointing steam pipes.
15. Testing of boilers.
16. Firing and raising and maintenance of steam pressure.

3. Bricklayers and Masons.

(18 months' course after completion of Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory.*—

- (a) Mathematics
 - (b) Drawing
- } As laid down on page 3.

2. *Related Theory.*—

- (a) Object of the trade.
- (b) Bricks—classification, types in use, characteristics and sizes. Manufacturing processes of different types of bricks including fire bricks.
- (c) Stones—principal types, properties, selection of stones and their uses. Methods of quarrying and dressing.
- (d) Tools common to the trade—description, use and maintenance.
- (e) Mortars (lime and cement)—ingredients, proportions, methods of mixing their respective strengths and uses.
- (f) Bends—various kinds and application.
- (g) Technical terms common to the trade.
- (h) Foundation—ordinary standard types, damp-proof courses, etc.

Soils.

- (i) Principles of construction of lintels and arches.
- (j) Methods of erecting scaffoldings, shutterings, etc.
- (k) Principles of reinforced brick and concrete work.
- (l) Description and methods of constructing chimneys, flues, fire places, stair cases, etc.
- (m) Setting out buildings with details of brick and masonry work.
- (n) Drawings and plans of various types of brick and masonry work—reading, and understanding specifications. Calculation of materials and working out rough estimates.
- (o) Supervision of trade labourer's work.
- (p) Safety precautions.

Practical.—(28 hours per week throughout the course).

1. Setting out work with tape and rule.
2. Use of plumb bobs, squares, levels, lines, etc.
3. Cutting and dressing stones and bricks.
4. Cutting and laying stone flags.
5. Mixing lime and cement mortars.
6. Laying bricks and stones in simple bonds.
7. Constructing straight lengths of wall—brick.
8. Constructing straight length of wall—stone (random and coursed rubble).
9. Constructing walls with openings for door and window frames.
10. Cutting out and forming openings of given sizes in brick and stone walls.
11. Constructing corners—right angle, circular, obtuse and acute angles—inside and outside.
12. Cement rendering, pebble dashing and fitting of glazed wall tiles.
13. Constructing rooms of regular and irregular shapes with door and window openings.
14. Ramming and finishing floors.
15. Constructing roofs—tile, brick and concrete including, cutting tiles to shapes.
16. Plastering.

17. Mixing concrete and making simple beams and columns in reinforced concrete.

18. Fixing of shuttering, bending reinforcement and casting of simple pre-cast concrete lintels and castings in situ.

19. Completing various jobs in brick, masonry and concrete work involving, the construction of arches, fire places, flue stacks ; stair cases, culverts, etc.

20. Pointing and finishing.

21. Laying and joining concrete, earthenware and stoneware pipes.

4. Carpenters and Joiners.

(18 months' course after completion of Basic Training).

Theoretical.—(12-hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory*.—

(a) Mathematics, as laid down on page 3.

(b) Drawing, as laid down on page 3 and to include drawing of all types of carpenter's joints with details.

2. *Related Theory*.—

(a) Object of the trade.

(b) Different varieties of timber—classification, description, properties and uses.

(c) Seasoning of timber—principles of natural, water and artificial seasoning. Shrinkage of timber.

(d) Diseases and defects of timber—description, causes, how detected and their effects.

(e) Preservation of timber and the common processes of treatment.

(f) Market forms of timber and trade terms.

(g) Ply-wood—description, how manufactured, advantages, disadvantages and uses.

(h) All hand tools common to the trade, detailed description and uses.

(i) Necessity of special attention required for the maintenance of tools. Grinding and sharpening of tools, saw setting, etc.

(j) Wood working machines, common types—description, manipulation and maintenance. Safety precautions.

(k) All types of joints—description, proportions and uses.

(l) Jointing materials—nails, screws, hinges, etc. Glue—preparation and uses.

(m) Principles of trussing as applied to various wood structures.

(n) Safety precautions, general.

Practical.—(28 hours per week throughout the course).

1. Correct care and maintenance of all tools, including grinding, sharpening and saw setting.

2. Correct methods of marking out.

3. Correct manipulation of hand tools involving, sawing, planing, chiselling, etc.

4. Constructing all forms of joints and instruction regarding where the joints are applicable.

5. Manufacture of articles, such as, Correspondence Trays, Straight and Slant Legged Stools, Office Racks, Shelves, Folding Tables, Folding Meat Safes, Tool Chests, etc.

6. Work involving, secret dovetailing, building up of curved work, such as circular rims; manufacture of doors, windows, wheel barrows and making complete pieces of furniture, etc.

7. Work involving wood turning, use of wood working lathes.

8. Constructing various roof trusses, stairs, etc.

5. Die Sinkers.

(18 months' course after completing Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval to be allowed between any periods which run consecutively).

1. General Theory.—

(a) Mathematics—General syllabus as laid down on page 3 and in addition calculations involving (1) Areas and volumes with special reference to cones pyramids, spheres, etc. (2) Forces and pressures. Speeds of shafts, pulleys and chain gears. Moments (leverage) of force.

(b) Drawing—General syllabus as laid down on page 3 and in addition, problems in practical geometry, such as, construction of regular pentagons, ellipses, helix, etc.

2. Related Theory.—

(a) Object of the trade.

(b) Metals and Alloys—As laid down on page 3 with special reference to malleability, ductility, melting points, tensile and compressional strengths.

(c) All fitter's tools—their detailed description, such as, characteristics of files (shapes, size, cut, grade, etc.); hacksaw blades, what differences necessary when used on different materials and of varying thicknesses; classification of drills, etc.

(d) Grinding of chisels, drills, etc. Angles to which these should be ground. (Special attention to be given to maintenance of all tools).

(e) Die Sinkers' special tools, such as specially shaped cutters, gravers, drifts, etc., their description, use, care and maintenance.

(f) All types of threads, nomenclature, and uses. Bolts studs, nuts, screws, washers, dowels, pins, etc., their description and uses. Templets, jigs and fixtures.

(g) Limit systems and gauges. Precision instruments—description and manipulation, with special attention to care and maintenance of—Micro-meters, Vernier Callipers, Vernier Height gauges and Protractors, Feeler gauges, Dial Test Indicators, etc.

(h) Machine Tools—Description (with schedule of parts), use, care and maintenance of Lathes, Drilling, Shaping, Milling and Grinding Machines.

(i) Tools for machines—description, use, care and maintenance of Lathe and Shaper tools, Milling cutters, Drills, Reamers and Grinding wheels. Cutting speeds and fluids.

(j) Soldering and Brazing—principles of processes. Blow lamps. Solder & Spelter, different compositions and uses. Fluxes.

(k) Construction and description of various types of punches and dies, viz., Blanking, Cutting, Bending, Forming etc.

(l) Process of metal forming and calculation of blanks.

(m) Hand and power presses—the principal types, their description, construction, use and maintenance.

(n) Fits; limits and clearances.

(o) Heat treatment of metals—annealing, hardening, tempering and case hardening.

(q) Types of gearing. The principles of lubrication and its various applications. Commonly used mechanical motions and their application. Conversion of motion, etc.

Practical—(28 hours per week throughout the course).

1. Fitting.—Marking off, accurate use of surface plates, V-blocks, scribing blocks, height gauges, etc.

2. Working accurately to the markings involving, chipping, filing, drilling, sawing, tapping, screwing, scrapping, etc. Correctly maintaining all tools, including grinding and sharpening of tools.

3. Turning.—(Centre and Chuck work)—straight, taper and form turning, screw-cutting,—outside and inside. Correctly maintaining all tools by grinding.

4. Shaping—Surfacing, Grooving, side cutting, angle and under cutting. Correct maintenance of all tools by grinding.

5. Milling—Surfacing, slitting, fluting, angular milling, simple indexing.

6. Grinding—Cylindrical and flat surface grinding, straight and taper grinding—inside and outside.

7. Lap finishing for very fine work.

8. Practical die making, including the use of machines and hand tools, and annealing, hardening and tempering.

(a) Making templates for dies.

(b) Making punches and dies for cutting out in press plain blanks of simple geometrical form.

(c) Making punches and dies for use in the machine shop, for example, washer dies, bending dies for right angle bends, etc.

(d) Making "Gang" and "Follow" dies.

(e) Bending and forming dies, such as, Buckle die, Bending die for wire staple, Dies for safety pins, etc.

(f) Making built-up dies.

(g) Dies and punches for Sport caps Ash trays, Toy train wheels, Button dies, dies for screwed caps, etc.

(h) Polishing and finishing punches and dies.

(i) Assembling and fitting dies and punches and testing them in hand and power machines.

(j) Engraving letters, signs, etc.—use of pantograph.

6. Draughtsmen (Mechanical).

(18 months' course after completing Basic Training).

N.B.—Other than one week of each month, remaining time at 40 hours per week throughout the course to be spent in the drawing office.

1. Lectures and demonstration on uses of drawing instruments, their care and maintenance. Methods of sharpening pencils etc. Notes on style and convention, lettering and printing. Plane geometry, exercises embracing essential principles to enable trainees to execute drawings and projections accurately. Scales, uses and construction of, plain and diagonal. Simple sketching.

2. Lectures and notes on representations on plane surfaces of 3 dimension objects, 1st angle English projections. Solid geometry—simple projection. Dimensioning technique. Sketches on screw threads. B.S.W., B.S.F., B.S.P., square thread, buttress, Sellers, acme, single start and multi-start threads. Geometrical projections of threads. Notes and sketches on bolts and screws: detailed working drawings of square and hexagonal headed bolts, studs foundation bolts, eye bolts, crane hooks, turn buckles etc. Notes and sketches on locking arrangements.

3. Lectures and notes on Engineering fastenings, rivets—types proportion and application with sketches. Notes and sketches on rolled steel sections, riveted structures, built up girders, etc.

4. Lectures and notes on conic section and interpenetrations. Developments and problems for sheet metal work. Drawings and projections of simple machine parts. Uses of simple formulæ on Mensuration and Trigonometry.

5. Lectures, notes and sketches on cast iron, steel, and wrought iron pipe joints and fittings. Dimensioned drawings to be made from plates. Line shafting, bearing, pulleys, keys, couplings, brackets—dimensioned drawings to be made from plates and models. Limits and fits—tolerances. Explanations and uses of tables. Lectures and notes on micrometer. Sketching—*isometric projection*.

6. Elementary mechanics—mass, velocity, acceleration, force, work and energy. Moments of forces, simple strain and stresses. Newton's laws of motion. Theory of heat engines—principles of steam engines and boilers. Boiler mountings, I.C. engines. Elementary electricity and magnetism—magnets, magnetic properties, electrical units Ohm's law. Primary and secondary cells. Principles of generators and motors.

7. Instruction on Engineers pocket hand book—use of tables, formulæ, etc. Machine drawing, screw jack, steam engine details, various types of bearings, clutches, stop valve, etc. Drawing to metric convention. Ball and roller bearings, detailed sketches from components, measurements being taken and working drawings made. Bearing housings and assembly, etc., automobile stub axle, etc.

8. Geometrical projection of cycloid, epicycloid and involute curves. Notes and sketches on gear wheels, machine drawing of gear wheels, layout of bevel gears. Automobile differential and gear box details. Machine tool parts and assemblies—lathes, drilling shaping and milling machines, etc.

9. Lectures and notes on tracing (tracings to be made of suitable drawings). Blue printing technique.

10. Lectures on manufacture of parts, pattern making, use of fillets and allowances for shrinkage to enable correct dimensioning.

11. Practice in making complete drawings, tracings and blue prints. Geometrical projections of practical use. Lectures on machining and setting up parts, to enable correct dimensioning.

12. General revision of lectures and notes. Practice in making complete working drawings including developments for sheet metal work.

Workshop Instruction.

(This should constitute one complete week, *i.e.*, 40 hours of each month throughout the course).

1. Lectures and notes on various metals used in Engineering. Demonstration and tests to recognise these metals. Explanation of the processes of hardening and tempering, case-hardening, normalising and annealing. Smith's work demonstrations.

2. Lectures and instruction on measuring instruments and marking out work. Pattern making and foundry work demonstration.

3. Lectures and instruction on chipping, filing, scraping, sawing, drilling and reaming. Hand press and its work. Shafting, bearings, belting, pulleys, couplings and brackets.

4. Lectures and instruction on Power drilling, tapping, screwing and precision reaming countersinking counterboring, spot facing, etc.

6. Lectures and instruction on centre lathe work, nomenclature and functions of parts, chucking, boring and facing turning between centres, calculating and setting up trains of wheels for screw-cutting (simple and compound trains).

6. Shaping, planing and slotting machines—nomenclature and functions of parts, setting up of work, travel, etc.

7. Milling machine—nomenclature and function of parts, cutters of common types, different milling operations, dividing head, general setting up.

8. Grinding machine—nomenclature and function of parts, grinding wheels, allowances, setting up, etc.

Note :—Trainees must be encouraged to make sketches of parts of machines and tools. As far as possible, they should each do a job on every machine and a series of exercises must be given embracing the fundamental functions of the machines.

7. Electricians

(18 months' course after completing Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. General Theory.—

- (a) Mathematics. } As laid down on page 3.
(b) Drawing }

2. Related Theory.—

- (a) Object of the trade.
(b) Metals and alloys—as laid down on page 3.
(c) Safety rules with particular reference to Electricity.
(d) Magnetism—magnet, properties of magnet, magnetic materials, lines of force and magnetic field, magnetism of earth.
(e) Electrical signs, and symbols.
(f) Electricity—Electric charge and behaviour of electrically charged bodies.
(g) Conductors and insulators—their meaning and examples. A list of common conductors and insulators, their description, properties and uses.
(h) Series and parallel—meaning.
(i) Electric pressure—its meaning and definition. Potential difference. Volt.
(j) Electric current—definition and meaning. Direction of flow of current in relation to Potential difference. Ampere.
(k) Electric resistance—definition and meaning. Its effect on flow of electric current. Ohm.
(l) Electrical energy—definition and meaning of work and energy. Electrical energy—Watt, Kilowatt, K.W.H. mechanical equivalent of Electrical power
(m) Ohm's Law—definition, explanation and calculations.
(n) Primary and secondary cells—working principles, construction, care and maintenance.
(o) Cells and conductors in series and parallel.
(p) Battery charging—care of plants and batteries, precautions and methods of charging. Charging boards—different types.
(q) Electro magnetic induction—solenoids and transformers, their working principles and descriptions.
(r) Generators and motors, their working principles, construction and parts.

(s) Armature—its construction, components and winding (lap and wave).

(t) Starters and regulators, their construction and functions.

(u) Electrical circuits—light and power. Circuit diagrams—reading and drawing. Making out specifications.

(v) Electrical measuring instruments—Voltmeter, Ammeter, Energy meter, Megger, their description, working principles and construction. Use, care and maintenance.

(w) Electrical circuits of common types of motor vehicles—ignition and light.

Practical.—(28 hours per week throughout the course).

1. Drawing maps of magnetic fields.
2. Measuring resistance of a conductor.
3. Verification of Ohm's law.
4. Verification of rules for working combination of cells.
5. Making all types of joints in single and multi-stranded cables and wires, including soldering and sweating.
6. Carrying out mechanical repairs of electrical appliances, viz., switches, plugs, cut outs, regulators, etc.
7. Laying out of different types of wiring including the use of conduits for both light and power circuits.
8. Carrying out wiring and repairs of electrical circuits of motor vehicles.
9. Connecting and running all types of A.C. and D.C. motors and carrying out simple repairs viz., fitting and bedding new brushes, lapping and undercutting commutators, etc.
10. Testing rotors and starters for earth, open circuits, insulation, continuity, etc., and carrying out necessary repairs.
11. Winding (Lap and Wave) armature cores and field coils.
12. Battery maintenance work including topping up, washing out, mixing and filling electrolyte of batteries. Battery charging including constructing D.C. lamp type charging boards. Repair work of batteries including lead pouring.
13. Testing of commercial types of energy meters.
14. Lead burping.

8. Engine Artificers.

(18 months' course after completing Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory.*—

- | | |
|-----------------|---------------------------|
| (a) Mathematics | } As laid down on page 3. |
| (b) Drawing | |

2. *Related Theory.*—

- (a) Object of the trade.
- (b) Metals and alloys—as laid down on page 3.
- (c) All fitter's tools, detailed description, such as, characteristics of files (shape, size, cut, grade, etc.) ; hacksaw blades, why differences necessary in the number of teeth when used on different materials and of varying thicknesses ; classification of drills, etc.

(d) Grinding of chisels, drills, etc., and the angles to which these should be ground.

(e) All types of threads, nomenclature, uses, etc. Bolts, nuts, studs, washers screws, etc., their description and uses.

(f) Soldering and brazing—principles of processes. Blow lamp. Spelter—different compositions and respective uses. Fluxes.

(g) Precision instruments—Micrometers, Vernier Callipers, Vernier Height Gauge and Protractors, Feeler gauges, Speed Indicators, etc., their manipulation, care and maintenance.

(h) Machines—Lathes, Drilling and Valve grinding machines, their description, parts, use, care and maintenance. Tools used in connection with these machines.

(i) Working principles of I.C. engines—the 2 stroke and 4 stroke cycles. Essential difference between compression—ignition and spark ignition systems.

(j) Common types of I.C. engines—Petrol, Diesel, Semi-diesel (vertical and horizontal), their description, construction, principal parts and functions of these.

(k) Principle of carburation. Common types of Carburettors—description and working.

(l) Principles of valve timing and its relation to engine performance. Fuel oil filters, injectors, etc.

(m) Cooling systems—air and water. Circulation of coolants.

(n) Silencers, their working principles and essential features.

(o) Fire, frost and safety precautions.

(p) Common types of steam engines, description, construction, principal parts and function of each.

(q) Working principles of Steam engines—single and double acting, condensing and non-condensing, simple and compound.

(r) Valve, valve gears and eccentric—description and essential features. Angular advance of eccentric and its effect on engine performance. Mechanism of link motion.

(s) Governors.

(t) Lubrication systems, pumps, lubricators, etc.

(u) Pipes and flanges.

(v) Boilers—types, boiler mountings, and accessories.

Practical.—(28 hours per week throughout the course).

1. Bench Fitting—Marking off accurately using surface plate, V-blocks, scriber blocks, height gauges, etc., and working accurately to the markings involving, chipping, filing, drilling (hand and machine), reaming, screwing, tapping, scraping, etc.

2. Turning work—Straight and taper turning (inside and outside), screw-cutting.

3. General Exercises.—

(a) Brazing and soldering pipes, nipples, etc.

(b) Removal of broken studs.

(c) Threading and jointing of pipes.

(d) Overhauling and maintaining of the various types of fuel feed systems.

(e) Decarborising, grinding and adjusting valves, including the rebuilding of engines after cleaning or overhaul.

(f) Adjusting of engines timings (valves, ignition and fuel pump, etc.).

(g) Dismantling and re-assembling of various types of engines (replacement of worn parts).

(h) Dismantling and cleaning and refitting of lubricators, all types (mechanical and sight).

(i) Making all types of joints, including the cutting of gaskets from joint paper.

(j) Scraping and fitting of bearings.

(k) Lining up and fitting of cranksafts and connecting rods.

(l) Packing glands.

(m) Facing up, bedding and adjusting steam engine slide valves.

(n) Repairing of boiler feed pumps, injectors and safety valves.

(o) Use of boring machines and bars, use of portable honing machines.

(p) Reconditioning valves and seats with special machines.

(q) Cutting of valve seats.

(r) Fitting of valve inserts.

The above syllabus will only be worked to if a definite demand exists for this type of mechanic.

9. Fitters.

(18 months' course after completion of Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory.*—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

2. *Related Theory.*—

(a) Object of the trade.

(b) Metals and alloys—as per general syllabus laid down on page 3.

(c) Tools—all fitter's tools with detailed description, such as characteristics of files (shape, size, cut, grade, etc.) ; hacksaw blades, the number of teeth in relation to the choice for use on both different materials and their respective thicknesses ; classification of drills, etc.

(d) Grinding of chisels, drills, etc. Angles to which these should be ground. (Special attention to be given to maintenance of all tools).

(e) Threads, all types, nomenclature, uses, etc. Bolts, nuts, screws, washers, pins, etc., their description and uses.

(f) Soldering, continuing to Brazing. Principles and processes. Blow lamps. Solder—different compositions and uses. Fluxes.

(g) Heat treatment—annealing, hardening and tempering.

(h) Use of templets, jigs and fixtures.

(i) Ratchet Brace and Drilling machine—description with schedule of parts, manipulation, care and maintenance. Cutting speeds and use of Cutting fluids.

(j) Pulley and gear ratios. Types of gearing. The principles of lubrication (various applications). Commonly used mechanical motions and their application. Conversion of motions, etc.

(k) Limit systems and gauges. Precision instruments—Micrometers, Vernier Callipers, Vernier Height Gauges and Protractors. Dial Test Indicators, etc., their manipulation with special attention to care and maintenance.

Practical.—(28 hours per week throughout the course).

1. Correct maintenance of chisels, scribers, scrapers, drills, spanners, pliers, punches, etc. Grinding and sharpening as necessary of the above.

2. Marking out from drawings using surface plate, V-blocks, scribing block, etc.

3. Working accurately to markings involving chipping, filing, drilling (hand and machine), sawing (hand and machine), tapping, screwing, etc.

4. Precision filing and scraping and use of precision instruments.

Note.—All exercises will lead up to the completion of an assembly in order to keep trainees interested.

5. Elementary Machine Shop practice.

6. Assembling small components involving the use of spanners and fitting split, cotter and taper pins, and employing various kinds of nuts, screws, bolts, rivets, washers, etc.

7. Inspection and testing of manufactured articles.

8. Forging of tools, such as punches, chisels, etc., annealing, hardening and tempering of these tools.

9. Brazing pipes and flanges to pipes.

Note.—About half way through the syllabus a period from two to four weeks to be spent in the machine shop doing elementary work on lathe, shaper and slotter.

10. Grinders.

(18 months' course after completion of Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory.*—

- | | |
|----------------|------------------------|
| (a) Arithmetic | } As laid down page 3. |
| (b) Drawing - | |

2. *Related Theory.*—

- (a) Object of the trade.
- (b) Metals and alloys—as laid down on page 3.
- (c) Safety precautions with special attention given to grinding machines.
- (d) Common types of grinding machines—Surface, Plain, Universal, their description, parts, manipulation, special attention being given to care and maintenance of machines.
- (e) Special types of grinding machines—Cutter grinder, Form, Thread, Centreless grinders, etc., their description, parts, manipulation, care and maintenance.
- (f) Various types of grinding wheels—shape, size, Abrasive composition, Grit, Grade and Bond.
- (g) Selection of grinding wheels for different types of work, materials and finish.
- (h) Dry and wet grinding.
- (i) Speed, feed, direction of rotation of work and wheel. Conversion of peripheral speeds to revolutions per minute. Heat generated in grinding and use of coolants.
- (j) Rough and finish grinding. Different fits, limits and grinding allowances.
- (k) Precision instruments—Micrometers, Vernier Callipers, Vernier Height Gauges and Protractors, Vernier Depth Gauges, Dial Test Indicators, their description and use, special attention being given to care and maintenance.
- (l) Conversion of taper sizes—inches per foot to degrees, etc.

(m) Application of jigs and fixtures to surface grinding, face plate work, etc.

(n) Allied machines—Lathe, Shaping and Milling machines, their description, parts, use, care and maintenance.

(o) Forged and tipped tools, the various grinding angles.

(p) Construction of drills, reamers, taps, milling cutters, etc. Calculation of clearance angles on milling cutters, drills, etc.

(q) Production methods when working on mass production basis.

Practical.—(28 hours per week throughout the course).

1. General Grinding Exercises—

(a) Setting up of work in the machines including use of magnetic chucks.

(b) Mounting of grinding wheels.

(c) Operating various grinding Machines.

(d) Cylindrical grinding—straight (external and internal).

(e) Taper cylindrical grinding (external and internal).

(f) Grinding long cylindrical work using sliding rest.

(g) Flat surface grinding (straight and taper).

(h) Dressing, balancing and truing grinding wheels.

(i) Remedying faults when grinding, such as, vibration and chattering.

(j) Grinding of thin work.

(k) Grinding different materials to specifications.

(l) Precision grinding—gauges.

(m) Fluting of drills, taps, reamers, etc. Grinding milling cutters, etc.

2. Extra curriculum exercises—

(a) Lathe work—Straight, taper and form turning (outside and inside).

(b) Shaping machine work—Surfacing, side, angular and undercutting.

(c) Milling machine work—Surfacing, fluting, side milling and simple indexing.

11. Instrument Mechanics.

(18 months' course after completion of Basic Training).

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory.*—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

2. *Related Theory.*—

(a) Object of the trade.

(b) Metals and alloys—as laid down on page 3.

(c) All fitter's tools peculiar to Instrument Workshop, their detailed description, construction, use, special attention being given to the care and maintenance necessary.

(d) All types of threads, nomenclature and uses. Bolts, studs, screws, nuts, washers, etc., their description and uses.

(e) Soldering and Brazing—principles of processes. Blow-lamps, Solder and spelter, different compositions and uses. Fluxes.

(f) Heat treatment of metals—annealing, hardening, tempering and case hardening.

(g) Precision instruments—Micrometers, Vernier Callipers, Vernier Height Gauges and Protractors, Dial Test Indicators, etc., their manipulation, mechanism and construction, special attention being given to care and maintenance.

(h) Machines—Precision lathes, Drilling and Engraving machines, their description (with schedule of parts), respective tools, use, lubrication, cutting speeds, with special attention to care and maintenance.

(i) Fits, limits and tolerances. Taper conversion (inches per foot to degrees, etc.).

(j) Calculation of speed in chain gear wheels.

(k) Use of templets, jigs and fixtures.

(l) Applying instrument finish on work, viz., bronzing, lacquering, bluing, etc.

(m) Elementary Electricity and Magnetism.

(n) Primary and Secondary cells, their working principles, construction and charging.

(o) Magnetic induction, principles of Motors and Generators.

(p) The construction and simple theory of Telephone and Telegraph receivers and transmitters, Bells, Relays, Electrical Measuring Instruments, etc.

(q) Elementary optics—reflection, refraction and magnification. Prism, Lenses and Condensers.

(r) Optical instruments—working principles and construction of different types of telescopes, Survey instruments, Collimators, Periscopes, Microscopes, etc.

Practical.—(28 hours per week throughout the course).

1. Bench Fitting Work—marking off accurately using surface plate, V-Blocks, scribing blocks, height gauges, etc.

2. Working accurately to the marking involving, chipping, filing, drilling (hand and machine), sawing, tapping, screwing and scraping.

3. Grinding and Sharpening of Tools.

4. Making small tools, screw-drivers, callipers, etc. Soft and hard soldering. Tempering of small springs. General heat treatment.

5. Turning tools and simple turning work, parallel and taper, in ferrous and non-ferrous metals. Screw-cutting, drilling and boring.

6. Use of watchmakers lathes, manufacture of grub screws, small steady pins, taper pins, etc.

7. General light instrument workshop practice, making instrument components involving measurements, gauging, polishing, lapping, finishing, calibrating and fitting.

8. Repairs and adjustments of instruments—Monoculars, Binoculars, Directors, Dial sights, Rangefinders, Prismatic compasses, Speedometers, Electrical measuring instruments, etc.

12. Machinists.

(18 months' course after completing Basic Training).

Theoretical.—(12 hours per week throughout the course). A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory.*—

(a) Mathematics.

(b) Drawing.

} As laid down on page 3.

2. *Related Theory.*—

- (a) Object of the trade.
- (b) Safety precautions as applied to machine shops.
- (c) Metals and alloys—as per general syllabus laid down on page 3.
- (d) All fitter's tools—their detailed description, such as, classification, characteristics, etc.
- (e) Common form of screw threads. Bolts, Nuts, Studs, etc., their description and uses.
- (f) Limit systems and gauges. Precision instruments—description, manipulation, special attention being paid to care and maintenance of Micrometers, Vernier Callipers, Vernier Height Gauges and Protractors, Dial Test Indicators, etc.
- (g) Fits and tolerances.
- (h) Heat treatment of metals—annealing, hardening and tempering.
- (i) Shaping, Planing, Slotting, Drilling and Milling machines—description, types of machines, parts, etc. Driving mechanism, quick return motion, travel, automatic feeds, etc.
- (j) Cleanliness, lubrication, operation of machines, special attention being given to their care and maintenance.
- (k) All types of forged and tipped tools, their description, different grinding angles, necessity of keeping tools properly ground; selection of tools, tool holders, etc.
- (l) All types of milling cutters, description, construction, selection of cutters, their proper care and maintenance (special attention being given to this).
- (m) Metals, their cutting speeds (feet per minute), feed and lubrication. Relation of feed to speed and the relation of these to finish, output, etc.
- (n) Methods of fixing work on table—vices, clamps, jigs and fixtures.
- (o) Indexing head—description, calculation of simple indexing, reading of indexing tables. Calculation of gear-blanks.
- (p) Mass production methods.

Practical.—(28 hours per week throughout the course).

1. Planing, shaping and slotting machine work.

- (a) Correct grinding of tools.
- (b) Study of machines, cleaning, lubricating, etc.
- (c) Marking out of work.
- (d) Setting work of light, heavy, regular and irregular shapes (use of vice, clamps, jigs, etc.).
- (e) Setting travel and feed.
- (f) Fixing cutting tools.
- (g) Carrying out different machining operations, viz., surfacing, side cutting, grooving, under cutting, angular cutting, including both roughing and finishing.
- (h) Forging and heat treatment of tools.
- (i) Checking of manufactured articles.

2. *Milling machine work.*—

- (a) Study of machines, cleaning, lubricating, etc.
- (b) Marking out of work.

(c) Setting travel, feed, etc.

(d) Fixing of cutters.

(e) Carrying out different milling operations, viz., plain milling, side milling, slitting, milling key-ways, angular milling, straight fluting, Straddle and gang milling, linear indexing, circular indexing, spur gear cutting, cutting racks and pinions cutting worm gears, fluting twist drills, etc.

3. Elementary grinding.

4. Elementary turning.

13. Motor Mechanics.

(18 months' course after completion of Basic Training).

Theoretical—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. General Theory.—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

PART I.

2. Related Theory.—

(a) Object of the trade.

(b) Metals and alloys—as laid down on page 3 with special reference to Aluminium alloys.

(c) All fitter's tools—their detailed description, such as, classification, characteristics of files, drills, etc., special attention being given to proper maintenance and care, including grinding and sharpening.

(d) All types of screw-threads, their nomenclature, description and uses. Belts, studs, nuts, screws, washers, pins, etc., their description and uses.

(e) Soldering and brazing—description of processes. Solder and Spelter—different compositions and their respective uses. Fluxes. Blow lamps.

(f) Heat treatment of metals—annealing, hardening and tempering.

(g) Lathes and drilling machines—description, parts, function of parts, manipulation and care of machines. Lathe tools, description and uses. Cutting speeds, and use of cutting fluid.

(h) Pulley and gear ratios. Commonly used mechanical motions and their application. Conversion of motions.

(i) Fits, limits and tolerances. Precision instruments—Micrometers, Vernier Callipers, Vernier Height Gauges and Protractors, Dial Test Indicators, Feeler, Screw-pitch, Wire gauges, etc., description manipulation and necessity of their proper maintenance and care.

PART 2.

(a) General description of motor vehicles of conventional type, the major assemblies and their functions.

(b) Theory of I.C. engines. The two and four stroke cycles. Sequence of valve operation. Reasons for use of multiple cylinders. The principle of compression-ignition system and the essential difference between the C.I. and spark-ignition systems.

(c) Engine constructional details and mountings. Description and functions of—Cylinders and cylinder heads. Crank-case and oil sump. Crankshaft and main bearings. Fly-wheel. Connecting rods, big end bearings, gudgeon pins. Pistons and piston rings. Valves, valve inserts,

valve springs and tappets. Camshaft, camshaft bearings and timing wheels. Distributor and oil pump drive. Exhaust and inlet manifolds. Exhaust pipe and muffler. Governors. Engine mountings. Joints and gaskets. Lubrication systems (splash and forced feed systems), feed oil pump, filter and pipe lines.

(d) Carburation and types of carburettors in common use, their working principles and construction. Functions and action of choke. Air cleaner.

(e) Fuel supply system—gravity, pressure and vacuum feed systems. Pumps, filters and autovaacs. Gas producer plants.

(f) Cooling systems—air and water systems of cooling. Pumps and impellers, radiator, mountings, hose connection, Fan.

(g) Magneto and coil ignition systems. Spark plugs. Battery, dynamo, self starter. Distributor and ignition cables.

(h) Transmissions—torque in successive elements of the transmission system from engine to axle shafts. Clutches, different types, their working principles, methods and limits of adjustment, springs, plates, and linings. Stopping and grabbing of clutches—reasons and cure. Gear boxes and transfer cases—common types of gearing mechanisms. Universal joints—both metal and fabric types. Lubrication and lubricating systems of the above components.

(i) Differential and rear axle—worm, bevel and spur gear differentials. Hypoid rear axle drive. The rear axle, description, bearings, etc. Lubrication and lubricating system.

(j) Steering and front axle—steering gear, castor, methods of castor adjustment. General adjustment of linkage. Alignment of front wheels. The front axle, description, bearings, etc. General causes and cure of wheel wobble.

(k) Chassis—the frame and suspensions. Methods of attachment of body and various assemblies. Springs and springing. Types of shock absorber, construction and function.

(l) Brakes—hand and foot brakes, servo and hydraulic type of brakes, their working principles, construction and adjustments.

(m) Wheels and tyres—types of wheels and tyres, their repair and maintenance.

(n) Lighting systems.

(o) Bearings—plain, ball, roller, spiral, etc., description, comparison and uses.

(p) Controls—description and operation of the various controls, dash board accessories etc.

(q) Lubricants—essential properties and different kinds of lubricants needed for the different components of automobile.

(r) Instruments and special tools.

(s) Service station equipment and arrangement.

Practical.—(26 hours per week throughout the course).

1. *General Workshop Practice.*—

(a) Marking off accurately from drawing, using surface plate, V-blocks, try square, marking block, height gauge, etc.

(b) Working accurately to markings involving, chipping, filing, hack-sawing, drilling (hand and machine), tapping and screwing.

(c) Elementary lathe work—straight and taper turning, drilling and boring.

(d) Forging tools, annealing, hardening, tempering and grinding.

(e) Simple soldering.

2. Automobile work.—

(a) Removing a tight nut, a broken screw or stud, reaming and bushing. General cleaning, oiling and greasing of cars.

(b) Wheels and tyres—repairing punctures, installing tyres on wheels, checking wheel bearings for wear, nutting of wheels.

(c) Brakes—examining brake drums, shoes and linings and relining and adjustment.

(d) Chassis frame, springs, etc.—inspecting frame and brackets and carrying out repairs.

(e) Steering—removing, stripping, refitting and mounting steering gear and column. Replacement of worn parts. Adjustment of links, etc.

(f) Axles—inspecting, removing and stripping front and rear axles. Repair of worn and damaged parts. Assembling and adjustment of complete axles with wheels, springs, shock absorbers, brakes, etc.

(g) Differential and universal joints—dismantling, cleaning, refitting, including replacement of worn parts of different types of differential and universal joints.

(h) Clutch—stripping, washing, re-assembling, relining, mounting and adjusting.

(i) Gear box—dismantling, inspecting, replacement of defective gears and bearings, refitting and adjusting.

(j) Engine—Washing and changing lubricating oil. Facing, scraping and fitting main bearings. Inspecting pistons, renewing rings and gudgeon pins. Testing and cruing alignment of connecting rods. Turning and grinding valve and valve seats. Fitting springs, cotters and setting tappets. Valve timing. Removing cylinder head and decarbonising. Cleaning, repairing and adjusting carburettors, distributors, spark plugs, silencers, vacuum tanks, filters, pumps, radiators, thermostats, fan belts and fan bearings, etc. Cutting and fitting gaskets, making joints, changing pipe lines, hose pipe, etc. Dismantling of engine and complete overhauling with repair and change of parts where necessary including the fitting of valve guides and valve inserts.

(k) Engine and car performance—Service station tests for compression, uniform firing of cylinders, response to throttle, slow running, silence, etc. Road performance as affected by carburettor setting, ignition timing, etc. Driving and road testing.

14. Moulders.

(18 months' course after completion of Basic Training).

Theoretical—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively)

1. General Theory.—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

2. Related Theory.—

(a) Object of the trade.

(b) The solid, liquid and gaseous states of matter, change of state by heat.

(c) Heat—conduction and radiation. Temperatures—Fahrenheit and Centigrade standards, measurement of temperatures. Thermal expansion and contraction.

(d) Metals and alloys as laid down on page 3 with special reference to pig iron, its production and uses in the foundry. Different kinds and grading of pig iron. Cast iron, different kinds and influence of constituents upon its properties. Types of iron used for different classes of castings. Malleable cast iron. Various grades of cast steel. Brass, bronze and aluminium alloys. Melting points of metals.

(e) Moulding tools, description, uses and care.

(f) Moulding sands, different types, description and properties. Effect of size and shape of grain, moisture content. Ramming density and its effect on strength of moulds, etc. Mixing and conditioning of sands. Sand testing. The use of coal dust, blacking and parting powder. Defects due to moulding sands.

(g) Types of moulds—open and closed. Green, dry, skin-dry and loam moulding. Moulding boxes, drag, cope, wood boxes and snap flasks. Reinforcement of moulds. Effect of mould material on the rate of cooling and on the final constitution of the metal. Heated moulds. Permanent moulds. Risers, runners or gates and vents. Mould joints. Description of moulds for various types of castings, including castings necessitating irregular joints and complicated coring. Examples of simple loam moulding—design and construction including moulding from skeleton patterns.

(h) Cores—sands used in core making. Core binder. Core washers and paints. Preparation of cores, cores made from boxes, strickled or swept-up cores in loam and sand. Use of grids, core irons and core barrels. Venting cores, wax vents, cinders. Testing of core sands. Defects due to core sands.

(i) The foundry cupola—construction and operation. Coke and its properties. Coke ratio. Methods of charging the cupola. Blast pressure. The control of cupola melting. Fluxes. Cupola slag.

(j) Crucibles and ladles—description, use and care.

(k) Pouring of castings. Pressure of metal and gases on mould and cores. Weighting and securing the core and mould against movement. Changes occurring during cooling. How contraction and expansion of the casting vary with nature of the metal.

(l) Designs which produce defective castings. Defects in castings—drawing, blow holes, scabbing, cold shuts, swellings, etc.

Practical—(28 hours per week throughout the course).

Making green sand moulding—open and closed moulds involving—

1. Mixing and preparing sand.
2. Levelling and preparing bed (soft and hard).
3. Use of two and three part boxes, snap boxes, etc.
4. Use of parting and facing sands, plumbago and coal dust.
5. Use of all types of moulding tools.
6. Ramming, venting, repairing and finishing moulds.
7. Jointing moulds.
8. Use of lifters, nails, sprigs, chaplets, gagers and soldiers, clamps, etc.
9. Core making including drying and backing.
10. Making skin-dried moulds.
11. Preparing moulds from broken components and simple patterns.
12. Preparing moulds for straight and bent pipes, pipes with flanges.

13. Making moulds for pulleys and wheels.
14. Charging and firing cupolas.
15. Use of crucibles and ladles.
16. Pouring of metals.
17. Fettleing of castings.

15. Painters and Decorators.

(12 months' course after completion of Basic Training).

Theoretical—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory*.—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

2. *Related Theory*.—

(a) Object of the trade.

(b) All tools common to the trade—detailed description, use and maintenance, such as construction of brushes, characteristics of good brushes, preparation for use and care, etc.

(c) The principle pigments (primary colours), oils, driers and varnishes, their names, uses and distinctive qualities.

(d) The principle of colour mixing and matching.

(e) Hygienic precautions, cleanliness in working and economy of painting materials.

(f) Processes of preparation of surface and application of paints. Blow-lamp—construction, manipulation and care. Filling materials.

(g) Abrasive materials—processes of dry and wet rubbing.

(h) Arrangement and use of scaffolding.

(i) Atmospheric reactions, decay of paints and methods of preservation.

(j) Types of finish. Imitative representation of wood, marble, etc. The decorative use of staining, varnishing and polishing.

(k) Spray painting—description, manipulation and maintenance of plants and guns. Methods of spray painting.

(l) Processes of distempering—preparation of surface, materials and tools, mixing and application of distemper. Washable distempers, uses and limitations.

(m) Methods and precautions of glass cutting and drilling, tools and their manipulation. Methods of glass polishing.

(n) General safety precautions.

Practical—(28 hours per week throughout the course).

1. Preparation of putty.

2. Preparation of surface, involving burning off, rubbing down and cleaning. Notting, stopping, priming, etc.

3. Mixing of paints and varnish.

4. Application of paint or varnish (free hand work) to a prepared surface.

5. Setting out, drawing and lettering sign displays.

6. Cutting simple stencils and stencilling figures and alphabet.

7. Glazing, cutting and drilling glass.

8. Writing on glass including gilding.
9. Exercises on imitative representation of wood and marble, inlays, marquetry, mosaic, etc.
10. Exercises on spray painting.
11. Exercises on distempering.

16. Pattern Makers.

(18 months' course after completion of Basic Training).

Theoretical—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. *General Theory*.—

- (a) Mathematics—as laid down on page 3.
- (b) Drawing—syllabus as laid down on page 3 and in addition principles of isometric and oblique projections.
Interpenetration curves of solids of simple Geometrical shaped sections.
Drawing of ellipses, helix, etc.

2. *Related Theory*.—

- (a) Object of the trade.
- (b) Various types of timber—classification description, properties and uses.
- (c) Diseases and defects of timber and how detected. Preservation of timber. Selection of timber for various types of work connected to the trade.
- (d) All hand tools common to the trade—description and uses, special attention being paid to their care and maintenance, grinding and sharpening of tools.
- (e) Wood working lathe and turning tools—description, manipulation, care and maintenance. Safety precautions.
- (f) Metals and alloys—as laid down on page 3 with special reference to those used for castings.
- (g) Contraction allowances for castings of various metals. The contraction rule. Permissible taper amounts on different parts of a pattern. Machining allowances.
- (h) Methods of joining timber—common types of joints, proportions and uses. Glue-preparation and application. Screws, nails, dowels, etc.
- (i) Pattern shop sundries—fillets, rapping and lifting plates, lifting straps, varnish, etc., and their respective uses.
- (j) Description of types of moulds—open and closed. Green sand, dry sand, skin-dried, and loam mouldings. Moulding and core boxes, gagers, sprigs, etc.
- (k) Common defects of castings and causes—blowholes, scabs, swellings, defects due to contraction and sharp corners. Warping of castings.
- (l) Wood working machines—Thicknessing, circular and band saws, spindle machines and safety precautions necessary.

Practical—(28 hours per week throughout the course).

1. *General wood work*.—

- (a) Maintenance of hand tools including grinding, sharpening, etc.
- (b) Correct manipulation of hand tools, involving marking, sawing, planing, chiselling, etc.
- (c) Constructing all types of wood joints.
- (d) Wood turning—cylindrical, taper and form turning, boring, facing,

turning on face plate, etc.

(e) Forming cylindrical and various curved shaped bodies by built-up processes.

2. Practical pattern making, involving selection of timber for different types of patterns ; use of pattern maker's tools, special rule ; finishing, varnishing, etc.

Making patterns for solid and hollow castings.

(a) Straight pipes, crank levers etc.

(b) Shaft couplings.

(c) Pipe bends and flanges.

(d) Branch pipes.

(e) Machine and engine parts—simple.

(f) Lathe components.

(g) Wheels and pulleys.

(h) Rack, pinion and worm wheels.

(i) Bodies of valves and cocks.

(j) Casings for centrifugal and piston pumps etc

3. Elementary moulding and foundry work—

Open and closed moulding in green sand. Moulds from the patterns constructed should be made. Actual casting work should be carried out and defects in pattern making judged.

17. Plumber.

(18 months' course after completion of Basic Training.)

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. General Theory—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

2. Related Theory -

(a) Object of the trade.

(b) Metals and alloys as laid down on page 3 with special reference to sheet lead, its manufacture, weights and thickness. Gauging of sheet metal.

(c) All plumber's tools used in the trade, detailed description, uses, care and maintenance.

(d) Measurement of temperatures on Centigrade and Fahrenheit scales. Effect of heat on solids, liquids and gases.

(e) Soldering, brazing, sweating and wiping—description of processes. Solder, Spelter and Fluxes, different compositions and uses. Blow lamps, description, how operated, care necessary.

(f) Examples of jointing sheets of lead with laps, drips, welts and rolls ; flashings, etc.

(g) Description and uses of various types of pipes (lead, C. I. and W. I.), bends, elbows, reducing sockets, etc.

(h) Description and construction of common types of valves, cocks, taps, etc., used in connection with the supply of water and gases. Cisterns, fitting tanks, overflow pipes and their fittings.

(i) Domestic cold water supply system—general layout, description of materials required (pipes, valves, fittings, etc.). Connection of pipes to mains. Methods of jointing and fixing. Practical means of protect against frost. Methods of tracing leakage.

(j) Description of baths, sinks, basins, urinals, water closets, traps, etc. Arrangement and size of waste, soil and ventilating pipes. Connection to drains. Drainage fittings for C. I., earthenware and stoneware drains, use and methods of jointing. Preservative coating for iron pipes and fittings. Air-tight covers for disconnecting and inspection chambers; fresh air inlets.

(k) Domestic hot water supply system—general layout, description of materials required, their jointing, fittings, etc. Elementary principles of electric wiring circuit and heaters. Domestic boilers and geysers.

(l) Installation of gas pipes and fittings, meters, ventilation necessary.

(m) Reading of drawings and plans with special attention to sanitation and water systems.

Practical.—(28 hours per week throughout the course.).

1. Sharpening and maintenance of all tools.
2. Marking out, cutting and shaping sheet metal.
3. Developing and constructing simple articles, such as, pipes, funnels, rain water heads, etc., from sheet metal, and soldering and brazing.
4. Jointing pipes of different metals and diameters, including wiping on lead pipes and lead burning.
5. Cutting and screwing pipes and fitting sockets, elbows, etc.
6. Bossing external angles or corners of sheet lead. Forming rolls, welts, lining with sheet metal and flashing.
7. Bending and shaping pipes. Making 'S' traps.
8. Repair of valves, cocks, etc.
9. Erecting simple water supply system, including branching, setting up of baths, wash basins, water meters, etc.
10. Erecting simple gas supply system, including setting up of meters, valves, stoves, geysers, etc.
11. Erecting rain water piping system.
12. Erecting drainage piping system.
13. Tracing and repairing leak in various piping systems.

18. Textile Refitters.

(18 months' course after completion of Basic Training.)

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively.)

1. *General Theory*—

(a) *Mathematics*—recapitulation and problems in connection with the work carried out during Basic Training.

(b) *Drawing*—free-hand drawing from examples and illustrations of decorative patterns of woven figured textiles. Tracing, transferring, enlarging and reducing patterns. Drawing of conventional rosettes and flowers.

2. *Related Theory*—

(a) Object of the trade.

(b) All hand tools connected to the trade, detailed description, uses, care and maintenance.

(c) Basic materials used in the trade, such as wool, cotton, jute, silk, leather, etc.—description how obtained, classification and uses.

(d) Distinctive features and uses of yarns, thread, twine, cordage, rope, etc.

(e) Woven fabrics—distinguishing features, such as, face and back, order of warp and weft, amount and direction of twist in yarns, etc. Different commercial forms of woven fabrics.

(f) Elementary principles of blending, carding, spinning, twisting, reeling and weaving.

(g) Description of various processes of piecing, spacing and stitching, hemming, darning, patching, fitting of eyelets, etc.

(h) Preparation and jointing of leather.

(i) Sewing machines—different types, description, lubrication, manipulation, care and maintenance.

(j) Repair of water hoses and attaching fittings.

(k) Splicing rope and rope making.

(l) Upholstering—materials and processes.

(m) Safety precautions.

Practical.—(28 hours per week throughout the course.)

1. Maintenance of all tools.

2. Manufacture and repair of canvas buckets, nets, tents, cushions, leather cases and bags, water cisterns, etc.

3. Hand and machine sewing in repair and construction of canopies, tarpaulins, etc.

4. Repair and construction of the upholstery of automobile vehicles, rail coaches and furniture.

5. Riveting and eyeletting. Fixing of turn-buttons.

6. Darning blankets, socks, etc.

7. Fitting unions to delivery hoses.

19. Tin & Coppersmiths.

(18 months' course after completion of Basic Training.)

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively.)

1. *General Theory*—

(a) Mathematics

(b) Drawing

} As laid down on page 3

2. *Related Theory*—

(a) Object of the trade.

(b) Metals and alloys—as per general syllabus laid down on page 3 with special reference to sheets, viz. Black iron, Galvanised iron, Tinned sheets, Brass, Copper, Zinc, Lead and Aluminium sheets. How they are manufactured and designated. Commercial sizes of sheets of different metals.

(c) Hand and machine tools employed in sheet metal work—description, uses, care and maintenance. Comparison between hand and machine methods. The sheet and wire gauges.

(d) Principles and processes of soldering, sweating, tinning and brazing.

(e) The compositions and properties of solder and spelter and their uses. Compositions and characteristics of fluxes.

- (f) Blow lamps—description, manipulation, care and maintenance.
- (g) Shapes of notches and allowances for wiring. The various types of joints and the methods employed in jointing sheet metal.
- (h) Description of processes of raising, hollowing and planishing.
- (i) Effect of cold and hot working on sheet metals. Heat treatment—annealing, hardening and tempering.
- (j) Laying out and developing patterns for rectangular, cylindrical and conical shaped articles, tees, bends, elbows, intersection of pipes of equal and unequal diameters.
- (k) Principles of gas and arc welding as applied to sheet metal work. Description of plants and tools.
- (l) Precautions in working on petrol containers.
- (m) General safety precautions.

Practical.—(28 hours per week throughout the course).

1. Marking out and cutting sheet metal to required shapes; wiring and preparing various joints, including riveted joints.
2. Developing and constructing rectangular shaped articles.
3. Developing and constructing cylindrical articles.
4. Developing and constructing conical articles.
5. Developing and constructing Tees, Elbows, Bends, and pipes of equal and unequal diameters intersecting at different angles.
6. Brazing—butt and lap joints, unions, nipples, etc. Annealing of copper and copper alloy sheets.
7. Double curvature work (hollowing and raising) and tinning of vessels.
8. Repair of car radiators petrol containers, etc.
9. Extra curriculum work—short course on gas and arc welding, flame cutting.

20. Turners.

(18 months' course after completion of Basic Training.)

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively.)

1. *General Theory*—

- (a) Mathematics
 - (b) Drawing
- } As laid down on page 3.

2. *Related Theory*—

- (a) Object of the trade.
- (b) Safety precautions as applied to machine shops.
- (c) Metals and alloys—as laid down on page 3.
- (d) All fitter's tools—detailed description, such as, classification and characteristics, etc.
- (e) All types of screw threads, their nomenclature, proportion and uses. Bolts, nuts, studs, screws, etc., description and uses.
- (f) Limit systems and gauges. Precision instruments—description, manipulation and necessity of special attention to the care and maintenance of—

Micrometers, Vernier Callipers, Vernier Height Gauges and Protractors, Dial Test Indicators, etc.

- (g) Fits and tolerances.

(h) Heat treatment of metals—annealing, hardening and tempering.
 (i) The centre lathe—description, essential features and parts. Driving and automatic feed mechanisms.

(j) Special purpose lathes and their application in industry.

(k) Cleanliness, lubrication and operation of lathes. Importance of proper care and maintenance of lathes.

(l) Accuracy of work expected.

(m) All types of turning and boring tools, their respective grinding angles and necessity of maintaining properly ground tools. Selection and fixing of tools. Tipped Tools—description, advantages and disadvantages.

(n) Metals, their cutting speeds, feeds and coolants. Conversion of cutting speeds (revolution per minute to feet per minute). Rough cuts, rigidity of machine and tool, time factor. Relation of speed to feed and their relation to finish and output.

(o) Methods of setting up of work on centres. Centre drills and correct centering of work. Chuck and face plate work, including eccentric and contoured work. Mandrels and use of these.

(p) Taper turning, calculation of tail stock set over. Taper conversion (inches per foot to degrees) and tool post set over. Use of taper turning attachments.

(q) Screw-cutting—calculation of wheel change ratios.

(r) Mass production methods.

Practical.—(28 hours per week throughout the course.).

1. Lathe work—

(a) Correct grinding of tools.

(b) Centering.

(c) Plain turning.

(d) Roughing and finishing.

(e) Form turning.

(f) Facing.

(g) RADIUSING.

(h) Drilling and boring.

(i) Taper turning—internal and external.

(j) Screw-cutting—internal and external.

(k) Turning long work using centre rest.

(l) Precision turning and boring.

(m) Turning for various fits.

(n) Setting up on a face plate and boring of irregular shaped jobs.

(o) Eccentric turning.

(p) Indexing.

(q) Testing and truing alignment.

2. Forging lathe tools, annealing, hardening and tempering.

3. Extra curriculum work—a short course on shapers and slotters, and drilling machine work.

21. Welders (Electric Arc).

(18 months' course after completion of Basic Training.)

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively).

1. General Theory—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

2. Related Theory—

- (a). Object of the trade.
- (b) General principles of the process of welding.
- (c) Safety precautions related to the trade.
- (d) The solid, liquid and gaseous states of matter. Change of state by heat.
- (e) Heat—conduction and radiation.
Temperature—Fahrenheit and Centigrade standards, measurement of temperatures.
- (f) Metals and alloys—as laid down on page 3 with special reference to all materials which can be arc welded. Melting points of metals, plasticity, ductility, malleability at various temperatures, hardness and brittleness, etc. Combustion and oxidation of metals. Change of structure of metals and stresses set up by welding.
- (g) Heat treatment of metals—normalising, annealing, hardening and tempering.
- (h) Electricity—elementary theory. Electrical units and electric circuit. Relation of heat evolved with current and resistance. Circuit for arc welding.
- (i) Welding plant—description parts function of parts, manipulation and care and maintenance of plant. D. C. and A. C. welding—essential difference in plants, and safety precautions.
- (j) Electrodes—bare wire and covered electrodes, description, compositions and uses. Fluxes—different kinds, composition, object of using fluxes.
- (k) Striking the arc. Short circuit and method of release. Slag control. Voltage and current control in relation to arc length, amount of deposition, contour and thickness of metal.
- (l) Welding joints, different types. Preparation necessary.
- (m) Vertical and overhead welding, description of processes, correct angles for holding the electrodes, preparation and precautions.
- (n) Pre-heating furnaces—description and maintenance, including improvised type.
- (o) Methods of avoiding distortion, sequence of welding.
- (p) Defects in welds—faults due to manipulation, electrical conditions and material.
- (q) Testing of welds—destructive and non-destructive processes.
- (r) Safety precautions for welding petrol tanks and containers
- (s) Use of Jigs and fixtures.
- (t) Principles of resistance welding.
- (u) Principles of gas welding.

Practical.—(28 hours per week throughout the course.).

i. Horizontal, vertical and overhead welding :—

- (a) Study of the welding plant.
- (b) Striking the arc.
- (c) Simple straight bead deposition.
- (d) Welds—Different types of joints and preparation necessary.
- (e) Welding heavy and light section metals.
- (f) Building up bosses and collars.
- (g) Welding pipes and flanges.
- (h) Welding cracks in castings pre-heating when necessary.
- (i) Repairs to damaged castings including building up of worn parts.
- (j) Repair of motor car mud guards, petrol tanks, etc.
- (k) Heat treatment of metals.

(l) Welding special metals, such as, carbon steel, alloy steels, aluminum and its alloys, etc.

(m) Use of jigs and clamps for carrying out intricate welding.

(n) Inspection and testing of welds.

2. Extra curriculum work—a short course on—

(a) Brazing,

(b) Gas welding.

22. Welders (Oxy-Acetylene).

(18 months' course after completion of Basic Training.)

Theoretical.—(12 hours per week throughout the course. A period should not exceed 1 hour. A short interval be allowed between any periods which run consecutively.)

1. *General Theory*—

(a) Mathematics

(b) Drawing

} As laid down on page 3.

2. *Related Theory*—

(a) Object of the trade.

(b) General principles of the process of welding.

(c) Safety precautions related to the trade.

(d) The solid, liquid and gaseous states of matter. Change of state by heat.

(e) Heat—conduction and radiation. Temperature—Fahrenheit and Centigrade standards, measurement of temperatures.

(f) Metals and alloys—as laid down on page 3 with special reference to all materials which can be gas welded. Melting points of metals, plasticity, ductility and malleability at various temperatures; hardness and brittleness, etc. Combustion and oxidation of metals. Change of structure of metals and stresses set up by welding.

(g) Heat treatment of metals—normalising annealing, hardening and tempering.

(h) General description and properties of acetylene and oxygen. Heat evolved in an acetylene flame.

(i) Description and characteristics of high and low pressure systems. Generation of acetylene. Advantages and disadvantages of dissolved and generated acetylene.

(j) Welding plant—description, components and their functions. Care of plant. Tools and accessories.

(k) Regulators and blowpipes. High and low pressure blowpipes, various nozzles, their relation to the type of welding and thickness of metal.

(l) Welding rods and fluxes—Welding rods for steel, cast iron, copper and its alloys, aluminium and its alloys. Type of weld produced by various rods. Effect of welding rod diameter. Object of fluxes, characteristics and common types.

(m) The flame—carburising, oxidising and neutral, their description and uses. How gas is controlled.

(n) Welding technique—leftward and rightward welding. Advantages and disadvantages of the different processes. Relative speeds and cost.

(o) Welding joints of different types and preparation necessary.

(p) Flame cutting—hand and machine cutting processes.

(q) Importance of pre-heating. Pre-heating furnaces—description and maintenance, including improvised types.

(r) Defects in weld—observance of faults during welding, the indication of faults subsequent to welding, permissible corrections.

(s) Testing of welds—destructive and non-destructive processes.

(t) Safety precautions for welding petrol tanks and containers.

(u) Use of jigs and clamps.

Practical.—(28 hours per week throughout the course.)

1. Extra curriculum work—a short course on—

(a) Studying of the welding plant and regulators.

(b) Lighting flame and obtaining carburising, oxidising and neutral flames.

(c) Simple straight line deposits.

(d) Welds—different types of joints and preparation necessary.

(e) Welding heavy and light section metals.

(f) Welding bosses and collars.

(g) Welding pipes and flanges.

(h) Welding cracks in cast iron after pre-heating, when necessary.

(i) Repairs to damaged castings including budding up of worn parts.

(j) Flame cutting thin and thick sheets, pipes, etc.

(k) Repairing motor car mud guards, petrol tanks, etc.

(l) Welding special metals, such as carbon steels, alloy steels, aluminium and its alloys, copper and its alloys.

(m) Heat treatment of metals.

(n) Use of jigs, clamps, etc., for carrying out intricate welding.

(o) Inspection and testing of welds.

2. Horizontal and vertical welding—

(a) Brazing—using blow lamp and also blowpipe.

(b) Electric arc welding.