SYLLABUS FOR

TRACTOR MECHANIC

UNDER

CRAFTSMEN TRAINING SCHEME

&

APPRENTICESHIP TRAINING SCHEME

As Approved By
GOVERNMENT OF INDIA

In Consultation With
THE NATIONAL COUNCIL FOR
VOCATIONAL TRAINING
&
CENTRAL APPRENTICESHIP COUNCIL

Issued By
GOVERNMENT OF INDIA

MINISTRY OF LABOUR
DIRECTORATE GENERAL OF
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Revised

Sole Publishers & Distributors of
all Trades Syllabi

APA
3911, Roshanpura Nai Sarak
Delhi-110006 (India)
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General Information

1.	**Name of The Trade**	**:**	**Mechanic Tractor**
2.	N.C.O. Code No.	**:**	845.20
3.	Entry Qualification	**:**	(i) Essential: Should Have Passed 8th Class Examination under 10 + 2 System of Education or Its Equivalent. (ii) Desirable: Passed 10th Class Examination Under 10 + 2 Systems of Education with Science (With Physics & Chemistry As one of The Subjects) or Its Equivalents.
4.	Duration of Craftsman Training	**:**	1 Year
5.	Duration of Apprenticeship Training	**:**	3 Year Including 1 Year Basic Training
6.	Rebate For Ex – I.T.I. Trainees	**:**	(i) Full (ii) 1 Year (Farm Machinery)*
7.	Ratio of Apprentice to Workers	**:**	1:3

(*) NOTE : This Syllabus Is Same For First Year Syllabus of Mechanic (Agriculture Machinery or Farm Machinery)

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WEEK NO	PRACTICAL	THEORY	W/SHOP CALCULATION AND SCIENCE	ENGINEERING DRAWING
1	**2**	**3**	**4**	**5**
1.	Induction Training: Familiarisation with the Institute-importance of trade training. Introduction to machinery used in the trade-type of work done by trainees in the Institute-type of jobs done by the trainees in the trade, introduction to safety equipments and their uses etc	Importance of safety and general precautions observed in the section. Fire precautions for different types of fires-importance of the trade in the development of Industrial Economy of the Country-What is related instruction on the subject to be taught achievement to be made. Elementary First Aid. Recreational, Medical facilities and extra-curricular activities at the Institutes (All necessary guidance to be provided to the newcomers to become familiar with the Industrial Training Institutes system including stores, procedures etc.)		
2.	Use of Fitter hand Tools care and maintenance of tools, filing practice.	Safety precautions, description of Fitter's hand tools, chisels, hammers, hacksaw, files, drill, taps dies and surface plate etc. care and maintenance of tools.	Applied workshop problems involving multiplication and division, common, fractions, addition, substraction, multiplication and division application of fractions to shop problems.	Free hand sketching of straight lines, rectangles, squares circles, polygons etc.
3.	Filing-filing to line marking off-use of centre punch, dividers, calipers, steel, rule etc. Filing true and square.	Marking out, chipping and sawing hacksaw blades and its selection, cause of breakage of blades. Filing classification of files, different filing operation. Use of measuring instruments, vernier caliper etc.	Properties & use of cast iron, wrought iron, and plain carbon steel, high speed steel& alloy steel.	Free hand sketching with dimension and proportionate sketching.

4.	Chipping, grinding of chisels hacksawing.	Marking out for drilling. Ratchet brace-its manipulation and use. Hand drill brief description, operation & use. Flat and twist drills cutting angels and chisel.	Applied workshop problems as in week No.2.	Reading of simple blue print.
5.	Simple drilling. Use of taps and dies. Use of hand reamers.	Type of reamers-the manipulation and uses. Taps & dies-their uses.	Properties & uses of copper, Zinc, lead, tin, aluminium, brass, bronze, solder, bearing metals, timber and rubber.	Reading of simple blue print.
6.	Introduction to centre lathe, setting up work between centres. Use of side cutting tools. Parallel turning and stippled curning.	Safety precaution in the use of lathe-essential parts, their description and functions.	Decimal-addition, subtraction, multiplication, conversion of decimals to common fractions-shop problems.	Free hand sketching with dimension of simple solid such as cubes, rectangular blocks, cylinders etc.
7.	Jointing of metals by soft Soldering. Simple marking out of sheet metal. Joining of metals by gas & electric welding.	Sheet metal worker's common hand tools, their names and description. Safety precaution, simple forging process, simple heat treatment to cutting tools. Description of simple soldering and brazing fluxes used on common joints.	Brief description of manufacturing process of pig iron and cast iron.	Sketching of views of simple solid bodies as in week No.6 above when viewed perpendicular to their surfaces and axis.
8.	Simple sheet metal work cutting, bending & simple fold joints.	Sheet and wire gauges. The blow lamp-its uses and pipefittings.	Reduction of common fraction to decimal fraction-shop problems.	Sketching of views of simple solid bodies as mentioned when viewed perpendicular to their surface and axis.
9.	Pipe bending and annealing, fitting of nipples & unions by soldering, brazing by using blowlamp.	Description giving composition manufacture of various common engineering materials like cast iron, mild steel, brass, bronze, copper and aluminium.	Brief description of manufacturing process of steel, copper and aluminium.	Sketching of views of simple solid bodies as mentioned above when viewed perpendicular to their surfaces and axis.
10.	Measuring diameter of pistion, main journals, and crankpins. Big &main bearing, cyliper bore with ordinary caliper and micrometer and vernier caliper, telescopic gauge.	Description, proper handling of scale, feeler gauge. Calipers and precision measuring instruments, micrometer (inside/outside) vernier caliper, telescopic gauge. Dial test indicator & cylinder gauge.	Units Drive and fundamentals, type of system FPS, CGS, MKS and their conversion.	Views of simple hollow and solid bodies with dimensions use of different types of lines and symbols for drawing.

11.	General cleaning, checking and tightening of nut & bolts, study of different types of nuts & bolts, locking devices of tractor. Such as lock nuts, circlips lock rings lock washers and locating where they are used removal of broken stud/bolt from blind hole.	Study types and uses of temporary and permanent fasteners used in Tractor Agriculture Machineries. Description of types of threads, head and screw points of screws, Nuts.Bolts & studs and material used types of nuts, locking device key and splines, Description of chemical used as carbon remover antirusting & derusting solution.	Meaning of tenacity elasticity malleability, britileness, hardness, compressibility & ductility and their examples.	Free hand sketching of rivets and washers with dimensions from samples.
12.	Study and operation of General shop power tools & equipment such as pneumatic nut runner, riverting tools. Arbor press & hydraulic press.	General introduction and uses working safety of shop hand tools-type of screw drivers, spanners set, types of wrenches, plier punches and hammers, shop power tools & equipment function and maintenance, air compressor, Hoist Hydraulic/mechanical jack, Jack stand, support, lift (cranes) Hydraulic press arbor press; cleaning equipment Car Washer, cleaning tank, steam cleaner and Radiator flushing tank pneumatic tools for tightening and opening nuts &bolts.	Shop's problem on metric system of weight and measurement.	Free hand sketching of key and screw threads with dimensions from sample.
13.	General servicing of Tractor, washing cleaning, oil greasing and lubricating all moving parts of tractor and Inspection of all the major components. Use of mechanical hydraulic jack Car hoist, support wheel chokes.	Development of mechanical framing, use of Buldozer and tractor and various tractor assemblies and their function.	Effects of alloying elements on properties of cast iron & steel.	Free hand sketching of key and screw threads with dimensions from samples.
14.	Checking engine auxiliaries, fuel, and oil & cooling system. Practice in starting, running and stopping engine.	Description of various types of tractors in general uses their advantages and dis-advan-tages, chasis frame of tractor-construction details of a tractor. Reinforcement of engine mounting on chasis. Precautions observed while starting, runningand stopping the tractor.	Effects of alloying elements on properties of cast iron steel.	Free hand sketching of key and screw threads with dimension from samples.

15.	Study of different major components of tractor and their function and placement study of different make tractor in institute with different dealers or organizations.	Study of different major components & assemblies of tractor, and different make (indigenous). Tractor-name place-constructional differences and their merits.	Metric system weight and measurement units conversion factors.	Free hand sketches of nuts & bolts with dimensions from samples. Freehand sketching of different major assemblies of tractors.
16.	Removal of wheels from tractor, dismantling tire & tubes checking puncture by hot/cold patches and vulcanizing method, assembly--inflation to correct pressure according to field & road.	Description of different types of tractor wheel assemblies. Function & types wheel tires solid pneumatic & tubeless tires, constructional details, size description ply rating, trade design and their uses, types of rim.	Shop's problems on metric system of weight and measurements.	Free hand sketching of key and screw threads with dimension from samples sketching of different types of wheel rims.
17.	Dismantling tire to checking different rims, repairing, derusting, painting, re—assembling after changing direction of tire, for tyre rotation practice.	Wheel tyres and tubes-solid and pneumatic tyre- various types and sizes description and use. Fitting of inflating tyres to correct pressure. Repair & maintenance of tyre & tubes. Balancing of tractor wheels. Storage of tyres.	Ratio and proportion shop problems. Percentage & its application.	Views of simple hollow and solid bodies with dimensions. Use of different type of lines and symbols for drawings. Free hand sketching of tyres showing under over and proper inflation of tires.
18.	Fitting wheels on tractors-tightening wheel holding nuts in correct sequence. Measuring & setting different wheel track of front & rear wheel. Wheel base & ground height of different tractors.	Importance of wheel track, wheel base, ground height, description of steering geometry, chamber, castor, toe-in-toe-out on turning and effects of these angles.	Fits, limits, tolerance and allowances. Square root, perfect square. The square of a whole number and a decimal.	Explanation of simple orthographic projection-1st. Sketch showing direction of tire rotation of Tractor.
19.	Overhauling steering assembly including inspection, repair/replacement of parts from axles. Steering assembly and testing for correct function.	Steering – description construction & function of steering gear unit including wheel, rod, worm quadrant arm link, tie rood, ball and socket joints etc. their movement and adjustment. Description and mechanism of foot steerage pedals as incorporated in tractors.	Mass-unit of mass, force absolute unit of force. The weight of a body-unit of weight shop problem.	Explanation of simple orthographic projection 3rd engine. Free hand sketching system in Tractor.

20.	Study the working of power tiller in field starting operating clutch and steering system. Overhauling steering clutches & brakes of power tiller including dismantling, cleaning, checking & refitting, testing for correct functioning.	Description & working principle of the steering system. In power tiller (two wheel tractor) steering by brake Steering clutch & its description.	C.G.S. & F.P.S. system of units of force of force, weight etc. their conversion problems.	Views of simple hollow & solid bodies with dimensions. Use of different types of lines and symbols of drawing.
21.	Overhauling brakes including cleaning and inspection of all components, relining shoes, setting and actuating shoe clearance angle Inspecting spring of both shoe & lever Inspecting and setting hydraulic main brake including replacement of washer & Oil Seal. Overhauling serve mechanism (as applicable) inspecting piston & valves, bleeding and adjustment of brakes. Fault tracing & remedy.	Brakes types used or tractors, mechanical hand brake for sparking its fitting and adjustment. Description working principle and function of hydraulic brakes function of master & auxiliary cylinder. Bleeding & adjustment of brake serve system, layout &work principle brake, shoes & drums their fitting knowledge of disc type brakes.	Work unit of work energy power unit of power applied problems.	Views of simple hollow & solid bodies with dimensions. Use of different types of lines and symbols of drawing. Free hand sketching of braking system of tractors (Mechanical brakes system).
22.	Overhauling brakes including cleaning and inspection of all components; Relining shoes, setting and actuating shoe and lever. Inspecting & setting hydraulic main brake including replacement of washer and oil seals. Overhauling serve mechanism (as applicable), inspecting piston and valves, bleeding and adjustment of brakes. Fault tracing and remedy. Skimming of brake drum and disc plate.	Brakes-type used on tractor mechanical hand brake for parking, its fitting & adjustment. Description, working principal & function of hydraulic brakes, function of master & auxiliary cylinder, bleeding and adjustment of brake serve system, lay-out and work principle-brake, shoes & drums, their fitting, knowledge of disc type brakes.	Simple problems on work, energy & power.	Simple isometric drawing, isometric views of simple objects such as square, rectangles, cubes, rectangular block etc. Free hand sketch of working system Hydraulic brakes system showing detail description Master cylinder and wheel cylinders.

23.	Dismantling of unserviceable engine cleaning studying the parts of the engine and reassembling the engine, practice in use of correct tools & right procedure.	Description of internal & external combustion engines different types of I.C. engines. Important working parts in the engine the 4 stroke cycle of operation. Single cylinder. Types of engines fitted on tractors, various methods of starting various methods of starting of engine.	Meaning of friction examples, meaning of center of gravity-examples specific gravity examples.	Simple isometric drawing isometric views of simple objects such as square, rectangles, cubes, rectangular 0block etc, Free hand sketching of 4 stroke cycles & 2 stroke cycles of engine.
24.	Dismantling an unserviceable engine, cleaning of parts in the engine, measuring of cylinder bore-crank pins main journals, piston studying valve operating mechanism.	Diesel engines, both mobile and stationary types; Principal of working of diesel, semidiesel, kerosene, petrol and gas engines. Tow stroke cycle, operation difference between 4 stroke & 2 stroke cycle engines, Description of valve timing description & function of valve spring guide, toppets, valve seals & locks.	Mensuration-area of rectangles, squares, triangles, circles, regular polygons etc. calculation of areas.	Simple isometric drawings, isometric view of simple objects such as squares, rectangles, cubes, rectangular block etc. Free hand sketching piston assembly, valve assembly.

Achievements to be obtained by obtained by the Trainee after completion of mid session of Training.
Trade Competence.

1. To use measuring tools and instruments- compass, try square, feeler gauge-dial test indicator, vernier micrometer, pressure gauges, vacuum gauge Tachometer.
2. To handling machines and their accessories, such as simple drilling machine pedestal grinding power press, Lathe air compress Car Hoist and Car washer. Pneumatic Nut runner & riveting machine, etc.
3. To perform operation on tractor, clutch assembly, gearbox, differential steering brakes, etc.
4. To understand and solving calculation, problems related to the trade.
5. To know read, and understand: Simple blue print, read and making of free hand sketching.

25.	Cylinder head overhaul pressure testing, phasing decarbonising engines, facing valves & valves of seats and grinding valves on seats, fitting valves guides, fitting springs, caps, cotters & fitting of valves seats, inserts. Use of torques wrench, correct sequence of tightening cylinder head bolts.	Description and function of engine assemblies such as cylinder block, crank case, crank shaft- connecting rod, pistons, camshaft tappet and values.	Simple problems straight and bell cranked leavers.	Use of drawing instruments, T-square & drawing board. Free hand sketching of crankshaft showing all parts.
26.	Removing pistons and connecting rods from engine, dismantling, cleaning, inspecting checking clearances, installing rings and piston pins.	Description & function of different types of pistons, pistons pins-common troubles and remedy.	Calculation if volume and weight of simples solid bodies such as cubes, square and	Construction of simple and solids as mentioned above with dimensions & titles. Use of different types of scales in inches and millimeters.

			hexagonal prism-shop problem.	
27.	Removing connection rod assembly connecting rod alignment cleaning checking bearing clearances, replacing bearing shells, setting correct clearances. Measuring wear in crank pins and main journals in crank shaft.	Description & function of connecting rod Materials used for connecting rods big end & main bearings. Shells piston pins and locking methods of piston pins. Crank shaft description, function & type-common troubles & remedy.	Heat and temperature thermometric scale Fahrenheit and centigrade scales & their conversion. Name & use of temperature measuring instruments normally used in Workshop.	Construction of simple figures and solids as mentioned in week No. 26 with dimensions & titles. Use of different types of scales in inches and millimeters.
28.	Assembling crank shaft, main bearings, connecting rods and piston assembly in the engine, Tuning up engine for smooth slow speed running.	Firing order of the engine & crankshaft balancing description of the flywheel & its function. Crank case & oil pump. Valve timing diagram gears timing mark, Chain sprockets chain tensioner etc.	Heat and temperature thermometric scale Fahrenheit & Centigrade scales & their conversion. Name and use of temperature measuring instruments normally used in workshop.	Construction of simple figures & solid as mentioned in wee No. 24 with dimensions & titles. Use of different types of scales in inches & millimeters. Sketching valve-timing diagram.
29.	Checking cooling system for overheating, cleaning, radiators, dismantling, cleaning, assembling & testing water pumps, reverse flushing the system & adjusting the fan belt tension.	Engine cooling methods air & water cooling radiators, pumps thermostats and fan, their description, function care & maintenance. Reasons for engine overhauling.	Heat and temperature thermometric scale Fahrenheit & Centigrade scales & their conversion. Name and use of temperature measuring instruments normally used in	Lettering number & alphabet. Free hand sketching of different cooling system showing all necessary parts.

			workshop.	
30.	Studying the lubrication oil flow in engine overhauling oil filters, oil pump and setting the pressure release valve for correct oil pressure maintenance & repairs in the lubrication system in engine.	Need for lubrication of engine parts friction, lubrication oil & its properties lubrication system types-full flow bypass flow system oil filters and pumps type s their special features and uses.	Shop problems on determination of volume and weight of simple sold bodies.	Lettering number & alphabets. Free hand sketching of lubrication system filters and different type of oil pump, pressure release valve.
31.	Tracing of different parts of fuel system. Bleeding fuel lines for Air locks repairing fuel leaks in pipeline and unions cleaning of oil and air filters in diesel engines.	Fuel system-types & grades of fuel used-properties of fuel. Fuel. Used in diesel engines specification of diesel fuels. Importance of cleaning fuel general layout of the fuel feed system in the stationary and tractor diesel engine. Combustion & disadvantages heater plugs types uses.	Geometry properties of lines, angles, triangles & circles,	Free hand isometric sketching of simple objects with dimensions. Free hand sketching of feed system in diesel in diesel engines and fuel filters.
32.	Simple repairs in fuel feed system. Servicing of fuel filter & air cleaners.	Fuel feed system used in Tractors description and lay out of the system. Description, operation, maintenance, fuel filters and air cleaners.	Factor of safety examples. Different type of stresses example.	Free hand sketching isometric of simple dimensions. Free hand sketching of different type of injectors.
33.	Cleaning and servicing of primary fuel filter and pressure stage filters removing feed pumps dismantling, cleaning, reassembling, refitting and testing the feed pump.	Type of fuel injection pump systems-air injection fuel feed pumps description, operation, common troubles and remedy.	Effect of fuel on material in such application as extending, bending & shearing.	Free hand sketching of plain and elevation of simple objects like hexagonal bar, square bar, circular bar, tapered bar, hollow bar etc. Free hand sketching of single element plunger of fuel injection pump.
34.	Removing F.I. Pumps from running engine. Changing oil, fitting back to engine, testing the governor & setting injection timing.	Fuel injection pumps description & operation types, adjustment in the pumps phasing and calibration of pumps checking and fixing injection timing governors-types their description & operation, starting and adjustment of slow speed. Reason for black, white & blue smoke in exhaust.	Technical advantage, velocity ratio and applied problems.	Free hand sketching of plain and elevation of simple objects like hexagonal bar, square bar, hollow bar etc. Free hand sketching of air cleaner used in tractors.

35.	Testing injectors for missing on the Tractor removing, dismantling, cleaning, inspecting, replacing defective parts reassembling the injectors and testing them & setting injection timing in engines (both stationary and Tractor engine)	Injector nozzles types, description, operation, testing of injectors, special features of pintle nozzles. Timing of injection in single cylinder engine flange type pumps and their special features, care & maintenance of single cylinder pumps.	Useful work of machine- mechanical efficiency of machine. Problems.	Views of simple solid and hollow bodies cut by section plane.
36.	Practice adjusting clutch pedal play, removing gearbox and clutch assembly form tractor. Dismantling cleaning, inspecting, repairing clutch plates and pressure plate.	Layout of transmission system, description of frictional clutches, single and multiplates clutches, clutch lining Material, fluid coupling description and different adjustment troubles and remedies.	Machines- basic principles, determination of velocity ratio, mechanical advantage and efficiency.	Reading of simple blue print. Free hand sketching of clutch assembly.
37.	Overhauling gear Box, Transfer case, auxiliary gearbox.	Purpose of gearbox in tractor types of gearboxes. Constant sliding Mesh. Principal of epicyclical gear box. Auxiliary transmission. Low & lugs gear ratio, universal joint and propeller shaft.	Machines basic principle, determination of velocity ratio, mechanical advantage and efficiency.	Exercise on blue print reading. Free hand sketching showing different gear arrangement in gear box.
38.	Overhauling differential reduction gear, rear axle wheel hub & differential lock.	Differential carriers double reduction gearing, differential lock, Front wheel drive, crown wheel and pinion adjustments, power take off mechanism. Type front & rear axle's common trouble and their remedies care and maintenance.	Logarithm- use of logarithmic tables for multiplication & division.	Exercises on blue print reading. Free hand sketching of differential and reduction gearing system in rear axle.
39.	Study layout & operation of hydraulic system in tractor overhauling hydraulic system, pumps, control valves and remote cylinders.	Use of hydraulic system in tractor, types of pumps, control valves, safety valves, strainer & remote cylinders. Three point linkages, operating levers, study of different circuits. Description of depth/draft position. Operation of remote control in Hydraulic system, self sealing material used in system,	Determination of efficiency of simple machines like winch, pulley locks, wheel and compound axles.	Exercises on blue print reading. Layout of hydraulic system in tractor for life system.

		description of pressure hose pipe Fault finding & remedies in Hydraulic system.		
40.	Overhauling power tiller transmission system including main clutches, steering clutch/brakes mechanism-gear box and wheel & hub testing for field operation without implements and with implements. Driving practice with trolley/trailer.	Description, working principle & use of power tiller (two wheel tractor) power unit, Method of power transmission to wheel from engine. Main clutch assembling working procedure steering. Clutch/brakes mechanism method of power transmission to implement (Rotation), irrigation pump, thresher, Hitching of M.B. Plough, trailer disc harrow.	Further practice in the use of logarithm table.	Exercise on blue print readings.
41.	Servicing storage batteries electrical and starter systems.	Electrical equipments lighting arrangement in tractors (as applicable) including storage battery, dynamo, regulator switch and spot lights both front & rear. Maintenance of battery.	Electricity and its use, Electric current, positive terminals. Use of switches and fuse-conductors & insulators.	Free hand sketching of simple objects related to the trade & preparation of simple working drawing & preparation of simple working drawing & sketches. Free hand sketches of lighting system in tractor.
42.	Servicing storage batteries electrical and starter systems.	Electrical equipments lighting arrangement in tractors (as applicable) including storage battery, dynamo, and regulator switch and spot lights both front & rear. Maintenance of battery.	Ohms Law. Measuring current voltages-resistance in a circuit.	Free hand sketching of simple objects related to the trade & preparation of simple working drawing & preparation of simple working drawing & sketches.
43.	Tracing lighting circuit and fault rectification.	Description of lighting circuit, setting of regulator for correct charging rate, fault finding in electrical system.	Different forms of energy, neat mechanical and electrical examples, conversion from one to another.	Further practice in blue print. Reading & exercises related to the trade.

44.	Checking tractors implements such as disc harrow, grass cutter, lawn mower, Units etc. for serviceability before use and lubricating them as required. Fitting them for correct functioning.	Tractor equipment-description & function of offset and tandem disc harrow seed drill ploughs of different types etc. Fitting & fixing of equipment. Danger in overloading & incorrect hitching of ploughs. Average life of plough, shares and disc.	Generation of electricity AC & DC generators & motors Changing circuit in a Vehicle.	Further practice in Blue Print Reading & exercises related to the trade.
45.	Checking tractors implements such as disc harrow, grass cutter, lawn mower, Units etc. for serviceability before use and lubricating them as required. Fitting them for correct functioning.	Tractor equipment-description & function of offset and tandem disc harrow seed drill ploughs of different types etc. Fitting & fixing of equipment. Danger in overloading & incorrect hitching of ploughs. Average life of plough, shares and disc.	Plotting & reading of simple graphs.	Further practice in Blue Print Reading & exercises related to the trade.
46.	Visit to tractor Service Stations & observing use of servicing equipments. Study of Job cards. Process sheets. Studying Workshop system and layout. Importance of logs books.	Short description of various equipment used by service stations.	Meaning of Horse Power and Brake Horse Power. Simple problem on work energy & power rating.	Free hand sketching of simple objects related to the trade & preparation of simple objection working drawing from sketches.
47.	Exercise in driving a Tractor with different implements. Use of various types of meters dash boards instruments etc.	Description & function of tractor implements & accessories, Drawbar to correct height use of hydraulic lift & belt pulley mounted on tractors. Maintenance of tractor s. accessories, Driving, Servicing & maintenance of tractor, Motor Vehicle Act, Driving Rules.	Calculation of volume and weight of simple solid bodies by using logarithm.	Further practice in Blue Print Reading & Exercises related to the trade.

48.	Visit to Nearest Quality control Centre/Institution and factories to see their Quality control System and consult commercial Technical specifications. Services of exerts from the related university/Institution/Test agencies involved in Teaching/Testing to farm Machinery should and commercial Technical specifications.	All the standard available with Bureau of India Standard Institution and Quality Control Institutions related to Quality Control and Commercial Technical Specification to manufacture, fabricate and Safety, Visual, mechanical Inspection of product during and after final assembly, Functional Test of Sub assemblies and Test operations Maintenance/Calibration of Inspection of Test Equipment.
49. & 50.	Trouble shooting in Tractor driving & testing of the performance of a tractor & tractor driving with implement.	
51.& 52.	Revision and Final assessment.	

FINAL ACHIEVEMENT TO BE OBTAINED BY THE TRAIN AFTER COMPLETION OF 52 WEEKS TRAINING

TRADE COMPETENCE

1. To use measuring tools and instruments- Calipers, Compass, Try square, Feeler gauges, Dial test indicator, Vernier Micrometer, Pressure gauge, Vacuum gauge, Techometer & Compressure Gauge.
2. To handle machines and their accessories such as simple drilling machine, Pedestal grinding power press lathe & air compressor, etc.
3. To perform shop operation:

   Major assemblies of an engine Gear box, differential, steering, Brakes, Cooling system, Air induction system, Hydraulic system, Fuel system, Lubrication & cooling cleaning of the injector, electrical system etc.
4. Driving tractors and handling different controls while using implements.
5. Knowledge of oils and lubricants used in the maintenance of tractors and implements,
6. Understanding and solving calculations problems related to the trade.
7. To know, read and understand :

   Simple blue print, Reading & making of free hand sketching, Use of reference tables, purpose of safety precautions and regulations. Use of the fire extinguishers driving pre-

caution, read rules, proper maintenance of tractor, power tiller and tractor implements and accessories.

LIST OF I.S.I. BOOKS FOR TRADE OF FARM MECHANIC

Sl. No.	Title	I.S.I. Code No.
1	2	2
1.	Automative brake lining.	IS : 2742 – 1964
2.	Clutch facing for automotive transmission	IS : 3649 – 1966
3.	Glind bore diameters for I.S. engines.	IS : 3511 – 1966
4.	Fuel filters for diesel engines, methods of test	
5.	Fuel injection pumps, single cylinder.	IS : 1548 – 1964
6.	Dimension for injection nozzles. Size 'E' for diesel engines.	IS : 3170 – 1965
7.	High-pressure connections for Fuel injection equipment or diesel engines.	IS : 3173 – 1965
8.	Box spanners.	IS : 2030 – 1962
9.	Bolts and screw, dimension of ends of.	IS : 1368 – 1967
10.	Burden and tube pressure & vacuum gauge.	IS : 362 – 1965
11.	Oil cans (Part I). Light duty oil cans.	IS : 4561 – 1968
12.	Open jaw spanners.	IS : 2026 – 1968
13.	Toothed gearing glossary of term for.	IS : 599 – 1960
14.	Worm gearing.	IS : 373 – 1966
15.	Radiator hose.	IS : 2765 – 1964
16.	Lubricating oils, I.C. engine.	IS : 496 – 1966
17.	Grease multi-purpose No.1, 2, &3.	IS : 1002 – 1956
18.	Diesel fuels.	IS : 1460 – 1968
19.	Portable jacks for automobiles, mechanical & hydraulic.	IS : 4552 – 1968
20.	Valve grinding paste.	IS : 1004 – 1956
21.	Leaf springs for automobiles suspension.	IS : 113 – 1966
22.	Motor gasoline, 79 octanes.	IS : 158 – 1960
23.	Limits and fits for engineering recommendations for.	IS : 919 – 1963
24.	Ball and roller bearings, gauging practice for.	IS : 4025 – 1967
25.	Grease cups.	IS : 4672 – 1968

1	2	2
26.	Automobile lamps	IS : 1606 – 1966
27.	Automobile lighting and signaling devices, general requirement for.	IS : 3105 – 1966
28.	Automobile electric horn relays	IS : 2077 – 1962
29.	Distributors, methods of test for.	IS : 4036 – 1967
30.	Fuse boxes for automobiles.	IS : 4068 – 1967
31.	Ignition coils	IS : 2325 – 1963
32.	Sparking plugs methods of test for	IS : 1062 - 1963
33.	Starter for automobiles.	IS : 3141 – 1965
34.	Generators (Dynamos) for automobiles.	IS : 2646 – 1964
35.	Cartridge fuse links for automobiles.	IS : 2577 – 1963
36.	Lead acid storage batteries (Heavy duty) for motor vehicles.	IS : 985 – 1962
37.	Lead acid storage batteries (Light duty)	IS : 395 – 1962
38.	Engineering drawings, general code of practice for.	IS : 696 – 1960
39.	Data sheet for industrial tractors.	IS : 5008 – 1969

NAME OF TRADE-MECHANIC (TRACTOR)
List of Tools & Equipment for a batch of unit of 16 trainees

Sl. No.	Items	For Instructors	For Trainees
1	2	3	4
TRAINERS KIT			
1.	Hammer ball Peen 0.75kg.	1	16
2.	Chisel cold flat 20 mm x150mm	1	16
3.	Centre Punch 100mm	1	16
4.	Caliper outside spring 150mm	1	16
5.	Caliper inside spring 150mm	1	16
6.	Steel rule 15 cm English & Metric	1	16
7.	Screw driver 750mm x 6mm	1	16
8.	Screw driver 100mm x 8mm	1	16
9.	Spanner D.E.set of 6.7mm to 15x 16mm	1	16
10.	Pliers combination 150mm	1	16
11.	Hand file second cut 250mm	1	16
TOOLS MEASURING INSTRUMENTS GENERAL SHOP OUTFIT			
12.	Rule steel 300mm to read inches & mm		4
13.	Dividers spring 150mm		4
14.	Prick punch 150mm		4
15.	Chisel cross cut 9 x 3mm		4
16.	Chisel diamond point 9mm		4
17.	Chisel half round 9mm		4
18.	Hammer ball peen 0.5 kg.		4
19.	Hammer ball peen 0.5 kg		4
20.	Hammer copper 1 kg. With handle		4
21.	Hammer plastic 0.25kg with handle		4
22.	Engineers square 15 cm blade		4
23.	Scriber 150 mm		4
24.	Scribing block universal.		2

25.	Marking out table 90 x 60 x 90cm		1
26.	Surface plate 60 x 60 mm		1
27.	Hacksaw frame adjustable for 20 to 30 mm blades		4
28.	'V' block pair with clamps 7.5 x 3.75 cm		2
29.	Punch hollow 6. / and 9 mm set		2 Sets
30.	Punch letters set 3 mm		1 Set
31.	Punch number set 3 mm		1Set
32.	Hand Vice up to 375mm		2
33.	Screw drivers of different sizes	8 X 250 mm 10 X 300 mm 10 X 300 mm	4 sets one each size
34.	Phillips screw driver kit blades 5 mm dia		2 kits
35.	File flat 350 mm bastard		4
36.	File flat 250 mm second cut		4
37.	File flat safe edge 250 mm smooth		4
38.	File triangular 150 mm second cut		4
39.	File half round 400 mm second cut		4
40.	File flat 200 mm smooth		4
41.	File square 200 mm rough		4
42.	File square 200 mm second cut		4
43.	Drill twist S.S. 1/8" to ½" X 1/64" set		2 sets
44.	Drill twist metric # mm to 12 mm X 1 mm		2 sets
45.	Taps and dies complete set in box B.A., B.S.W., B.S.F. American and metric		1 set Each
46.	Rasp cut file – 250 mm		1
47.	H.S.S. hand reamers, parallel 8 to 12 by 1.5 mm		2 sets
48.	H.S.S. hand reamer adjustable 11 to 12, 12 to 13, 13 to 15, 15 to 16 mm.		1 set each
49.	H.S.S. hand reamer 3.5 to 12.5 mm in Steps of 1.5 mm set of 12		1 set
50.	Scrapper, flat 250 mm handled		4 set
51.	Scrapper, half round 250 mm		4
52.	H.S.S. machine reamers 3 to 19 mm in steps of 1.5 mm		1 set
53.	Scrapper, triangular 250 mm		4
54.	Scrapper, bearing		4

55.	Chaser hard W/V 9 to 40 T.P.I. set of 11 external	1 set
56.	Chaser hard W/V 9 to 40 T.P.I. set of 11 internal	1 set
57.	Set of Morse socket 0-1, 1-2, 2 & 3	2 sets
58.	Dial indicator to read 0.2 mm	2 sets
59.	Screw pitch gauge with 22 pitches from 9 to 40 TPI.	2 sets
60.	Micro-meter outside 0”-1”	2 sets
61.	Micrometer outside 0 to 25 mm, 25 mm to 50 mm	2 sets
62.	Micrometer outside 50 mm to 75 mm, 75 mm to 100 mm, 100mm to 125 mm, 125 mm to 150 mm	1 each
63.	Micrometer inside 25 mm to 50 mm with extension rod. 50 to 75 mm with extension rod.	2 each
64.	Vernier clipper set 150 to 200 mm inside and outside, depth to read inches and mm	1 each
65.	Safety goggles (care glass)	2 pair
66.	Hammer, planishing	2 pair
67.	Setting hammer	2 pair
68.	Mallet (wooden)	2 pair
69.	Trammel 300 mm	1
70.	Blow lamp	2
71.	Soldering iron 120 watt.	2
72.	Soldering iron copper 280 gms. (Fire Heated)	2
73.	Snipt straight, 250 mm	2
74.	Stake, hatchet type	2
75.	Stake grooving	2
76.	Grover- 3,4,6 mm	1 each
77.	Round long nose plier 150 mm	2
78.	Round fat nose plier 150 mm	2
79.	Round diagonal cutting plier 150 mm	2
80.	Slip joint plier 150 mm	2
81.	Wing compass 250 mm	2
82.	Circlip plier suitable for inner & outer circle look	2 each
83.	Pot malting	2
84.	Shovel	1
85.	Rake	1
86.	Poker	1

87.	Spanner double open ended set of 12 pcs. Size 6 X 7 to 27 to 32 metric set	4 sets
88.	Spanner double open ended set of 12 pcs. SAE ¼ X 5/16” to 1 1/8” X 1 1/4”	2 sets 2 sets
89.	Spanner double open ended set of 12 pcs. Size WW English 1/16” X 3/32” to 3/4’ X 7/8’	2 sets
90.	Spanner double open ended jaw long pattern. Spanner 6 X 7 to 27 X 32 mm	2 sets
91.	Water pump plier	2
92.	Pipe wrenches 250 mm, 350 mm, 450 mm	2 each
93.	Spanner adjustable 150 mm, 200 mm	2 each
94.	Spanner bihexagon Impact socket set 20 pcs. Size 12.5 mm (1/2”) 11 mm to 32 mm with speed handle, offset handle (sliding bar) angle handle, extensions and universal joint and ratchet handles	2 sets
95.	Spanner bihexagon Impact socket set 20 pcs. Size 12.5 mm (1/2”) SAE 3/8” to 1 ¼” with speed handle, offset handle (sliding bar handle) angle handle, extensions and universal joint and rachet handles	2 sets
96.	Double open ended tappet spanner from 11 X 12 mm to 16 X 17 mm	1 set
97.	Drift copper 150 mm of different dia	2 each
98.	Gun paraffin set	1
99.	Gun, grease pressure	1
100.	Chain & block 3000 kg. (3 ton)	1
101.	Tray cleaning assorted size	8 Nos.
102.	Drilling machine bench 1 H.P. to drill up to 12.5 mm dia	1
103.	Oil can pressure type	2 Nos.
104.	Valve spring compressure universal	2 Nos.
105.	Valve seat lapping tool suction type	6
106.	Valve seat lapping tools screwing type	1
107.	Valve seat cutting, tools complete with guides and pilot bar (all angle) and sizes cutter and stones type.	1
108.	Valve refacing Machine.	
109.	Stud extractor (suitable to drive all sizes of studs)	1
110.	Stud remover (suitable to remove all sizes of broken studs or bolls)	1set
111.	Compression gauge to read 0to250kg/sq.cm	1
112.	Vacuum gauge 0 to 75 cm.	1

113.	Fuller set for steering wheel universal	1set
114.	Fuller set universal for bearing and bushes	1set
115.	Connecting rod alignment fixture	1set
116.	Pneumatic Tools for tightening and opening Nut & Blots.	
117.	Pneumatic reveting tools.	
118.	Stone, carborandum 15*5*4cm. Smooth and rough.	1each
119.	Injector Testing machine (Hand tester)	1
120.	Cylinder Gauge capacity 6to15cm.	1
121.	Ring expander and remover.	1
122.	Torque Wrench (0to150 Lbs.-ft.)	1
123.	Ring groove cleaner.	1
124.	Ring compressor	2
125.	Torque Wrench (0to20 kg. metre)	1
126.	Torque Wrench (0to40 kg. metre)	1
127.	Workbench 255*120*60cm with 4 vices 12.5cm jaw.	4
128.	Lockers with 8n drawers (standard size)	2
129.	Metal rack 180*150*45cm slotted angle	3Nos.
130.	Fuel pump, Fuel feed pump	2each
131.	Injector pump, (Fuel injection pump)	2
132.	Dynamo and voltage regulator.	2each
133.	Starter motor.	2
134.	Hydraulic Pump, control valves (two types)	2
135.	Injectors (four types)	2each
136.	Water Pump & Oil Pump of different types	3each
137.	Feeler gauge for checking tappet clearance	2Nos.
138.	Feeler gauge for checking piston clearance	2Nos.
139.	Injector cleaning kit	2
140.	Filing jig for adjusting the pistons ring gap.	1
141.	Steel Almirah	4
142.	Instructor table	1
143.	Chair arm and without arm	3Nos.
144.	Fire extinguisher	2
145.	Fire buckets with stand	4
146.	Class furniture Dual desk with stool or benches	20Nos.
147.	Tachometer (counting type)	1

148.	Brake drum spring balance belt etc. for performance testing of engine.	1set
149.	Lifting jack screw type 3000 kgs.	4
150.	Equipment punctures, in box.	1
151.	Spray gun with accessories.	1

GENERAL INSTALLATION

152.	Grinder with two 18 cm wheels with twist drill grinding attachment.	1
153.	Compressor capacity 12c. Ft. piston type with pressure gauge (for inflating of tubes) spray gun etc.	1
154.	Hydraulic Jack HI-LIFT type (Trolley type)	2Nos.
155.	Car (Tractor) washer reciprocating type double piston electric operated with water tank and suitable hose pipe and nozzle.	1
156.	Various types of wall charts & cut models related to Tractor and Tractor's Services.	
157.	Power tiller 8/10 HP fitted with diesel engine And different accessories (trailor, M.B. plough, cultivator)	2Nos.
158.	Wheel type tractor fitted with diesel engine with standard accessories and special tools (25-35-45) Draw bar HP of different make.)	3
159.	Rotavator	1
160.	9 tine cultivator-spring loaded mounted type	1
161.	3 furrow disc plough with scrapers	1
162.	Ridger	1
163.	P.T.O. operated rotary lawn mower	1
164.	Rear axle assembly gear box steering box assembly of diesel engine tractor.	2 set each

NOTE : (1) No additional items are required to be provided for the batch/unit working in second shift except the items indicated under the trainees kit lockers for trainees.

(2) The specifications of the items in the above list have been given in metric units. The items, which are available in the market nearest to the specifications as mentioned above, if not available as prescribed, should be procured. Measuring instrument such as steel rule which are graduated both in English and metric units may be procured, if available.

APPROVED SYLLABUS OF PRACTICAL TRAING AND RELATED INSTRUCTIONS FOR THE TRADE OF MECHANIC TRACTOR UNDER APPRENTICESHIP ACT 1961.

The period of training for this trade is 3 years consisting of Basic Training for a period of one year and Shop Training for the remaining period. (The Syllabus for this trade should be considered as a guide for imparting Apprenticeship Training according to the facilities available in Industry)

List of operations/skills to be learnt during practical Training which includes Basic Training.

Note : (1) All freshers should undergo one year Basic Training followed by two years training/the shop floor. The apprentices should have more practice on the shop floor on these operations/skills which have already learnt during Basic Training and additional operations/skills during the shop floor training and develop the method of work, speed, and accuracy and finish the jobs.

(2) The content of one year training in Industrial Training Institutes in the trade is exactly the same as mentioned in (1) above. The trainees of ITI s who may be engaged for two years shop Floor training after one year training in Industrial Training Institutes should follow the same course for apprenticeship as in (1) above.

(The operations/skills which an apprentice will be required to carry out to cover the approved syllabus for practical training during a period of three years are as listed below. It is not necessary that the operations/skills should be performed in the order in which they are listed).

SI. No.	Operations/skills to be learnt during Basic Training
1	2
1.	Introduction to the trade and safety precautions.
Bench Fitting	
2.	Introduction and use of hand tools.
3.	Filing to line within an accuracy of $\pm$ 0.05mm.
4.	Chipping
5.	Grinding of Chisels
6.	Use of Calipers
7.	Use of precision measuring instruments.
8.	Scraping flat surfaces.
9.	Care and maintenance of tools.
Drilling Tapping and Reaming	
10.	Drilling including blind holes.
11.	Tapping by hand.
12.	Use of Stocks and dies.

13. Hand reaming.
14. Machine reaming.
15. Use of adjustable reamers.
16. Use of taper reamers.
17. Removal of broken studs.

Turning.

18. Care and operations of centre lathe.
19. Tool grinding (Lathe)
20. Use of chucks.
21. Turning within an accuracy of $\pm$ 0.005mm

Sheet Metal Work and Welding

22. Bending and rolling.
23. Soft soldering.
24. Brazing.
25. Pipe bending.
26. Fitting of nipples and unions.
27. Simple welding of Sheet Metal.
28. Are welding practice.

Power Unit of Tractor

29. Handling of tractor.
30. Engine removal.
31. Engine dismantling.
32. Checking of components of an engine.
33. Checking and fitting of main and big end bearings.
34. Fitting of pistons and rings.
35. Engine assembly.

Cooling System

36. Checking of cooling system
37. Overhauling water pump and radiator.
38. Study of fuel system.
39. Bleeding fuel system.
40. Fault finding and repairs.

Transmission System.

41. Clutch overhauling.
42. Gear box overhauling.

43. Overhauling of rear axle.

Steering and Brakes

44. Overhauling and adjustment of steering and brakes.

Hydraulic System

45. Overhauling of hydraulic system.

Under Carriage

46. Track adjustment

47. Minor repairs of tyres and tubes.

Electrical System

48. Maintenance & minor repairs of starters, dynamo and regulators.

49. Care and maintenance of batteries and tighting system.

Lubrication System

50. Lubrication system fault finding remedies.

51. Reconditioning of oil filters.

Tractor Implements

52. Checking implement for serviceability.

53. Hitching of implement.

54. Application, adjustment and maintenance of implements.

55. Driving of tractor with implements.

Trouble Shooting

56. Fault finding and remedies.

57. Use of manuals and catalogues.

58. Preparation of job cards and estimates.

Shop Training-2 Years

59. Instruction to safety precaution on shop floor.

60. Use of precision measuring instruments.

61. Care & maintenance of tools.

62. Use of center and pilot drills.

63. Tapping in lathe.

64. Reaming in lathe.

65. Joining metals by Arc welding.

66. Servicing of air cleaners of different tractors.

Cooling System

67. Overhauling of radiator.

68. Overhauling of water pump.

69. Flushing of cooling system.

Air Intake System

70. Refacing of valves on valve refacer.
71. Cutting and grinding of valve seats.
72. Tappet clearance adjustments.
73. Removal and fitting of valve seat inserts.
74. Bleeding fuel system.
75. Overhauling of feed pump.
76. Testing of injectors and overhauling.
77. Overhauling of fuel injection pump, fitting and timing setting.
78. Governer adjustments.
79. Check and service filter.

Power Unit

80. Measurement of ovality & taperness in cylinders and crank shaft.
81. Measurement of piston ring end gap.
82. Checking of piston groove for wears.
83. Reconditioning of cylinders.
84. Placing ring on pistons.
85. Reconditioning of crank shaft.
86. Fitting new liners and reboring where necessary.
87. Removal of ridge from cylinder bore.
88. Check, clearance between piston and cylinder bore.
89. Pressure test of cylinder block.
90. Method of tightening cylinder head bolts, main and big and bearing bolts.
91. Detect, cracks in cylinder head and cylinder block.
92. Checking oil clearance in big end bearing.
93. Engine-timing.
94. Checking oil clearance in big end bearings.
95. Connecting rod alignment.

Lubrication System

96. Checking of wearing gears & housing of oil pump.
97. Setting oil pressure relief valve.
98. Cleaning of oil filters.
99. Fault finding and remedies.
100. Checking for oil leaks in crank ear, value, cover, joint etc.

101. Installation of crank shaft in cylinder block.

Engine Assembly

102. Fitting main bearing.
103. Fitting pistons and connecting rods.
104. Fitting big end bearings.
105. Fitting head assembly.
106. Fitting of crank shaft, timing gears, oil pump assembly.
107. Fitting outside components and completing the engine assembly.

Clutch

108. Checking wear in clutch assembly components.
109. Adjustment of free play.
110. Clutch plate relining.
111. Attending minor repair

Transmission System

112. Checking different components for proper operation.
113. Fault finding and remedies.
114. Overhauling of final drive and differential.
115. Transmission (Gear Box) overhauling.
116. Repairing of P.T.O System & drive pulley.

Brake & Steering

117. Checking of brake components for serviceability.
118. Brake service including replacement of lining.
119. Fault finding, causes and remedies.
120. Checking of wear in ball socket joint of steering.
121. Care and maintenance of steering system.
122. Checking of wheel alignment, toe-in and toe-out.
123. Checking and overhauling of power steering.
124. Minor vulcanizing repairs on tyres and tubes.
125. Water ballasting of wheels.
126. Wheel track adjustment.
127. Remove and refit wheel.
128. Check and service under carriage components.

Electrical System

129. Wiring of tractor.
130. Checking of dynamo and minor repairs.

131. Minor repair on regulators.
132. Checking of self-starter and minor repairs.
133. Care and maintenance of electrical system.
134. Battery maintenance.
135. Prestarting inspection.

Hydraulic System

136. Dismantling hydraulic pump and checking for repairs.
137. Dismantling distributors, ram cylinder and actuating mechanism.
138. Fault finding and carry out minor repairs.
139. Fault finding, causes and remedies.
140. Use of service manuals.
141. Use of parts catalogues.
142. Preparation of list of parts for attending quick repairs.
143. Preparation of job cards and cost estimates.
144. Preparation of maintenance schedules for different makes of tractors.
145. Running in and engine test.

SYLLABUS FOR RELATED INSTRUCTION

Related instructions should be imparted to all the apprentices during the entire period of the training including basic training. The syllabus given for related instructions should be considered as guide.

The subjects to be taught to apprentices in related instructions:

1. Trade theory.
2. Workshop calculation & science.
3. Engineering drawing.
4. Social studies.

FIRST YEAR

The contents of the syllabus for the apprentices during first year training should be same as the contents of the one year course for I.T.I. trainees in this trade.

SECOND & THIRD YEAR

1. **Trade Theory** (3 Hours per week or 150 Hrs. per Yrs. Approx.)

(The number of hours to be spent on different topics in trade theory has been indicated. The hours indicated are flexible and are only intended as a guide.)

1. Safely at work-accidents do not happen. They are caused **6 Hours**
2. Revision of previous years work. **9 Hours**
3. **Materials of construction**

   Introduction, classification of steels, carbon steels, alloy steels, cast iron, white or chilled cast iron, malleable cast iron. **3 Hours**

4. Drilling machines- their brief description, operation and use, drilling machine accessories such as adopters, chucks etc. drill angles and their importance. Marking out of drilling. Drawing back for centre. Cutting speed and coolant, decimal equivalent of drill size. Table of cutting speed, feed and coolant. Calculation of drill size for tapping. **3 Hours**

5. Heat treatment of metals and alloys and its necessary definition of terms hardening, tampering annealing, normalizing and case hardening. Brief description and processes employed. Equipment used for heat treatment. Their manipulation, care and maintenance. Temper colour charts. **6 Hours**

6. Diesel Engine Working Principles & Terminology in brief. Two Stroke and four stroke operating cycles. Engine types. Comparison between diesel and petrol engines. Study of basic parts of an internal combustion engine and their function.

7. Cooling Systems; General description for tractor and earth moving machinery causes of over-heating. Anti-freeze and anti-corrosive compound-fuel system, care and handling fuel and lubricants.

   Petrol-types of fuels, derivation and uses, description and function of fuel system components. Types of system gravity feed, vacuum pressure feed and pump injection system, fuel pumps, air cleaners etc. Carburetors, diesel fuel system components fuel injection system-injection nozzles, fuel pumps, importance of fuel, filters etc. Governor's principles of operation, types and maintenance, lubrication fundamental of lubrication, oil film and welded theory, viscosity, S.A.E. number. Selection of correct grade of oil for a given job, Oil additives, bearings and bearing surfaces. Oil scale, types of lubricants. Importance of cleanliness. Engine lubrication system in use. **15 Hours**

8. Ignition System: Diesel-compression ignition, surface ignition (Semi-diesel)-firing order, Ignition Lag, detonation, combustion and pre-combustion chambers, Air system and filters, super chargers and turbochargers-effect of altitude on power output.

   Petrol-battery ignition system, and magneto system, Description of component parts. Sparking plugs, starting systems-general description, electrical systems auxiliary petrol engine, compressed air, in heat (Petrol/Diesel) system-hydro starters, Electrical systems: Description and function of components of electrical system-starting circuit and generating circuit. Battery-use, care and maintenance, voltage regulation, lighting circuits, A.C. Generators-Alternator and rectifiers. **12 Hours**

9. Clutches: Types of clutches, frictional air actuated and hydraulic Maintenance procedures and adjustments. Transmission System Tubes of gear boxes. Constant Mesh, sliding mesh syncromesh. Epicyclical gear system. Auxiliary transmissions Transfer cases and gear box components Torque converter, Power Shift transmission power take off system and pulley.

10. Different types of Hydraulic pumps, Check valves, practical study of different types of valves, Functional components of Hydraulic pumps, control valves, safety valves, Strainers, remote cylinders, three point linkages, operating levers, Study of different circuits, Fault finding and remedies in Hydraulics Systems. Self sealing used in remote control pressure hose pipe.

11. Drive lines and differentials : Propeller Shaft universal joints differential carries double reduction gearing, tandem drive units – reverse gear differentials- front wheel drivers, crown wheel and pinion pre-loading and backlash adjustment s, final drive –steering clutches, Steering brakes, ball and pinion gear – Maintenance, repair and adjustments.

12. General fault finding and service station test including road performance – control and dash board instruments, smoke analyzing and pollution control.

13. Machinery equipment : Compressor, spray pointing machine hydraulic elevator, valve grinder and reface valve seat grinder, cylinder boring machine, lubrication machine, lubrication machine and spark tester, wheel alignment gauge, jack etc,

their description, operation and use. Care and maintenance of machinery and equipment. **9 hours**

14. Mobile workshop : Layout and equipment including welding and cutting equipments.

15. Further description of tires &tubes : Dimensions and descriptions explanations of bend, side walls, cord body breaker strips tread, tube flap etc. ply rating, selections of tyres, carrying capacities, inflation pressures, loading, mounting and dismounting. Repair of minor damages & storages, valve repairs, tubeless tires –emergency repairs, vulcanizing& rethreading. **6 hours**

16. Breaks and breaking systems: Types of braking system in use mechanically operated, hydraulic servo breaks, air breaks, vacuum boosters, electric systems and air suspended systems-maintenance &adjustments. **6 Hours**

17. Steering systems :Descriptions of steering components –servicing procedures—explanations of camber, king pin inclination, castor. Toe-in and Toe out, wheel alignment and effect on steering. Power steering use of centre differential to aid steering. **6 Hours**

18. Use of handbooks, reference tables and Service manuals. **3 Hours**

19. Modern developments in the trade :New techniques ISI specification applicable to the trade etc. **3 Hours**

20. Introduction to work simplification related to the trade: Job analysis, job study including planning of sequence of operation. Critical approach and method of working, estimation of time and material, job handling. **12 Hours**

21. Quality and finish of work. Importance of quality and finish of jobs at all stages—protection of finished surfaces etc. **6 Hours**

22. Preventive maintenance :Its importance and systematic approach. **6 Hours**

23. Revision and test. **6 Hours**

NOTE: In 2years, 300 hours approximately should be spent and the time indicated above should be doubled.

2. Workshop Calculation and Science

(1 hour per week or 50 hours per year approx.)

1. Revision of previous year's work.

2. Mensuration: Area of circle and ellipse. Volume and weight regular cones and spheres. Calculations of area, volume and weight of simple hollow and solid bodies—applied problems.

3. Graphs: Plotting of points, plotting of graphs of simple equations, reading of graphs.

4. Advanced problems in mensuration work, power and energy.

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

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

7. Difference between pressure and force.

8. Determination of force on the piston, ram etc.

9. Torque and its relation to force on engine mountings and transmission.

10. Work and its measurement, calculation of work done by force on piston, torque on shafts, power in relation to engine output and road performance.

11. Friction-co-efficient of friction in bearing and slides, lubrication ball and roller bearings. Method of reducing friction.

12. Explanation of expansion of solid liquids and gases due to heat-coefficient of expansion. Brief description of transference of heat, conduction, convection and radiation.
13. Properties of water and lubricants in relation to heat Specific Gravity. Archimedes Principle, Laws of Hoatation. Viscosity-change of viscosity with temperature, importance of this relation to selection of lubricants for various purposes.

14. Properties of gases –compression and expansion of gases

15. Magnets : natural and artificial, poles of magnet, lines of force-magnetic field, earth magnetism.

16. Horse Power : Mechanical efficiency, fuel consumption per B.H.I. hour, means effective pressure.

17. Electricity and its various effects, electric current positive and negative terminals. Use of switches and fuses. Unit of current, resistance and voltage. Ohm's Law. Conductors and insulators, unit of power-watt and kilowatt relationship with horsepower. Board of trade unit, electricity circuits, causes of open and short circuits, measuring instruments :

Ameter, voltmeter, ohmmeter, megger, wattmeter. Types of circuits, batteries, magnets and electric magnets. Working of DC &AC meters.

18. Hydraulics-elementary principles. Incompressibility of liquids-properties of liquids-Pascal's Law.

3. Engineering Drawing

(2 Hours per week or Hrs. per year approx.)

1. Revision of previous year's work.
2. Development of surfaces of simple objects.
3. Drawing of reveted joints, different types of threads, bolts nuts and locking devices, keys, cotters, different types of couplings, bearings, pulleys, gears etc.
4. Construction of isometric scales.
5. Free hand sketching and production of working drawing of actual machine parts or engines parts or engines parts such as pistons, connecting rods, crank shafts, diesel injectors, tail stocks, tools post, engineer's vices, drill posts, ratchet brades etc.
6. Free hand sketching of detailed components from assemblies.
7. Free hand sketching of simple electrical circuits and reading of automotive electrical circuits. (IS : 732-1958)
8. Advance blue print reading.
9. Code of practice for General Engineering Drawing according to I.S.I. (IS : 696-1960).

NOTE : The list of tools for Basic Training is the same as for Mechanic (tractor) Craftsmen Training.