Detailed Syllabus for the post of JUNIOR INSTRUCTOR IN MECHANIC AGRICULTURAL MACHINERY IN Industrial Training Department -

(Cat.No:643/2023)

Module – 1st
Safety & Health , Basic Workshop Tools

1. Occupational Safety & Health : Importance of Safety and general Precautions to be observed in the shop. Basic first aid, safety signs - for Danger, Warning, caution & personal safety message. Safe handling of Fuel Spillage, Fire extinguishers used for different types of fire. Safe disposal of toxic dust, safe handling and Periodic testing of lifting equipment, Authorization of Moving & road testing vehicles. Energy conservation-Definition, Energy Conservation Opportunities (ECOs)-Minor ECos and Medium ECOs, Major ECOs), Safety disposal of Used engine oil, Electrical safety tips.

(4 Marks)

2. Hand & Power Tools:- Marking scheme, Marking material-chalk, Prussian blue. Cleaning tools- Scraper, wire brush, Emery paper, Description, care and use of Surface plates, steel rule, measuring tape, try square. Calipers-inside and outside. Dividers, surface gauges, scriber, punches-prick punch, center punch, pin punch, hollow punch, number and letter punch. Chisel-flat, cross-cut. Hammer- ball pein, lump, mallet. Screw drivers-blade screwdriver, Phillips screw driver, Ratchet screwdriver. Allen key, bench vice & Cclamps, Spanners- ring spanner, open end spanner & the combination spanner, universal adjustable open end spanner. Sockets & accessories, Pliers - Combination pliers, multi grip, long nose, flat-nose, Nippers or pincer pliers, Side cutters, Tin snips, Circlip pliers, external circlips pliers. Air impact wrench, air ratchet, wrenches- Torque wrenches, pipe wrenches, car jet washers Pipe flaring & cutting tool, pullers-Gear and bearing.

(5 Marks)

3. Systems of measurement: Description, care & use of - Micrometers- Outside and depth mirometer, Micrometer adjustments, Vernier calipers, Telescope gauges, Dial bore gauges, Dial indicators, straightedge, feeler gauge, thread pitch gauge, vacuum gauge, tire pressure gauge.

(4 Marks)

Fasteners: Study of different types of screws, nuts, studs & bolts, locking devices, Such as lock nuts, cotter, split pins, keys, circlips, lock rings, lock washers and locating where they are used. Washers & chemical compounds can be used to help secure these fasteners. Function of Gaskets, Selection of materials for gaskets and packing, oil seals. Cutting tools :- Study of different type of cutting tools like Hacksaw, File- Definition, parts of a file, specification, Grade, shape, different type of cut and uses., OFF-hand grinding with sander, bench and pedestal grinders, safety precautions while grinding. Limits, Fits & Tolerances:-Definition of limits, fits & tolerances with examples used in auto components .

(4 Marks)

Module – 2nd

Basic Workshop Machines , Basic Electricity and Heat Treatment

5. Drilling machine: Description and study of Bench type Drilling machine, Portable electrical Drilling machine, drill holding devices, Work Holding devices, Drill bits.Taps and Dies: Hand Taps and wrenches, Calculation of Tap drill sizes for metric and inch taps. Different type of Die and Die stock. Screw extractors. Hand Reamers – Different Type of hand reamers, Drill size for reaming, Lapping,
Lapping abrasives, type of Laps.

(4 Marks)

6. Sheet metal : State the various common metal Sheets used in Sheet Metal shop

Sheet metal operations - Shearing, bending, Drawing, Squeezing Sheet metal joints - Hem & Seam Joints Fastening Methods - Riveting, soldering, Brazing. fluxes used
on common joints. Sheet and wire-gauges. The blow lamp- its uses and pipe fittings.

(4 Marks)

7. Basic electricity: Electricity principles, Ground connections, Ohm's law, Voltage, Current, Resistance, Power, Energy. Voltmeter, ammeter, Ohmmeter Mulitmeter, Conductors &

insulators, Wires, Shielding, Length vs. resistance, Resistor Ratings

(5 Marks)

8. Fuses & circuit breakers: Ballast resistor, Stripping wire insulation, cable colour codes and sizes, Resistors in Series circuits , Parallel circuits and Series-parallel circuits, Electrostatic effects, Capacitors and its applications, Capacitors in series and parallel.

(4 Marks)

9. Description of Chemical effects: Batteries & cells, Lead acid batteries & Stay Maintenance Free (SMF) batteries, Magnetic effects, Heating effects, Thermoelectric
energy, Thermisters, Thermo couples, Electrochemical energy, Photo-voltaic energy, Piezo-electric energy, Electromagnetic induction, Relays, Solenoids, Primary & Secondary windings, Transformers, stator and rotor coils.

(4 Marks)

10. Basic electronics: Description of Semi conductors, Solid state devices- Diodes, Transistors, Thyristors,Uni Junction Transistors (UJT), Metal Oxide Field Effect Transistors (MOSFETs), Logic gates-OR, AND & NOT and Logic gates using switches.

(4 Marks)

11. Introduction to welding and Heat Treatment Welding processes : Principles of Arc welding, brief description, classification and applications. Manual Metal Arc welding -principles, power sources, electrodes, welding parameters, edge preparation & fit up and welding techniques; Oxy – Acetylene welding - principles, equipment, welding parameters, edge preparation & fit up and welding techniques;. Heat Treatment Process– Introduction, Definition of heat treatment, Definition of Annealing, Normalizing, Hardening and tempering. Case hardening, Nitriding, Induction hardening and Flame Hardening process used in auto components with examples.

(4 Marks)

12. Non-destructive Testing Methods : Importance of Non-Destructive Testing In Automotive Industry, Definition of NDT, Liquid penetrant and Magnetic particle testing method – Portable Yoke method Introduction to Hydraulics & Pneumatics: -

Definition of Pascal law, pressure, Force, viscosity. Description, symbols and application in automobile of Gear pump-Internal & External, single acting, double
acting & Double ended cylinder; Directional control valves-2/2, 3/2, 4/2, 4/3 way valve, Pressure relief valve, Non return valve, Flow control valve used in automobile. Pneumatic Symbols, Description and function of air Reciprocating Compressor. Function of Air service unit (FRL-Filter, Regulator & Lubricator).

(4 Marks)

Module – 3rd **(10 Marks)**

13. Tractor Engine Basics & Engine components

Engine Basics: Classification of engines, Principle & working of 2&4-stroke diesel engine (Compression ignition Engine (C.I)), Principle of Spark Ignition Engine(SI), differentiate between 2-stroke and 4 stroke, C.I engine and S.I Engine, Direct injection and Indirect injection, Brief on common rail diesel injection engine. Engine output, compression pressure, Compression ratio

Engine Components : Working principle & construction of cylinder heads, types of combustion chambers. Function of Engine Valves, different types, materials, Type of valve operating mechanism. Importance of Valve seats & inserts, importance of Valve movement, Valve stem, oil seals, Valve-timing diagram and concept of Variable valve timing.

Description of Cylinder block, Cylinder block construction: Types of cylinder blocks & cylinder liners. Description & functions of different types of pistons, piston rings and piston pins and materials. Used recommended clearances for the rings and its necessity precautions while fitting rings, common troubles and remedy.

Description & function of connecting rod : Importance of big-end split obliquely, Materials used for connecting rods big end & main bearings. Shells piston pins and locking methods of piston pins. Recommended clearances for the cylinder liners & rings. Bearing failure & its causes-care & maintenance.

Description of crankshaft & Camshafts : Types of their drives. Description of Overhead camshaft, importance of Cam lobes. Crankcase ventilation (PCV). Camshaft, Crank-shaft balancing, Firing order of the engine. Description and function of the fly wheel and vibration damper. Timing mark.

Cooling systems: Purpose, types, Heat transfer method, effect of boiling point & pressure, coolant properties, preparation and recommended change of interval, use of antifreezer.

Cooling system components : Water pump, function of thermostat, pressure cap, Recovery system & Thermo-switch. Function & types of Radiator.

Lubrication system: Purposes & characteristics of oil, type of lubricants, grade as per SAE, & their application, oil additives, type of lubrication system. Lubrication system components- different type of Oil pump, Oil filters & oil cooler. Probable reasons for low / high oil pressure, high oil consumption and their remedies.

Intake & exhaust systems : Description of Diesel induction & Exhaust systems. Description & function of air compressor, exhauster, Super charger, Intercoolers, turbo charger, variable turbo charger mechanism.

Intake system components : Description and function of Air cleaners, Different type air cleaner, Description **of** Intake manifolds and material.

Exhaust system components : Description and function of Exhaust manifold, Exhaust pipe, Mufflers- Reactive, absorptive, Combination, Electronic mufflers, Catalytic converters, Backpressure, Diesel particulate filter, Exhaust Gas Recirculation(EGR).

Module – 4th **(10 Marks)**

14. Tractor Transmission System & Power Tiller

Carburetor operation : Carburation, Carburetor system components, Carburetor systems, Metering jets, Accelerating, Carburetor barrels

Diesel Fuel Systems : Diesel fuel characteristics, concept of Quiet diesel technology & Clean diesel technology, Fuel feed system used in Tractor's description and layout. Diesel fuel system components, Description and function of Diesel fuel injection system, types of fuel injection pumps, type of drive, injectors-types and function. Governor and their types. Distributor-type injection pump, Glow plugs, Cummins & Detroit Diesel injection Diesel electronic control- Diesel electronic control systems (DEC), Common rail diesel injection system.Method of bleeding fuel supply system

Clutch : Types, construction and function. Components of clutch -driver & driven plates, torsion spring, cushion springs, operating fingers, clutch shaft, Slave cylinder & oil seal. Clutch release bearing & linkages.

Manual transmissions : Function, description, types and their application. Gearbox layout. Components of tractor gear box. Principle of epicyclical gear box. Necessity of torque convertor, need of 4 x 4 wheel drive / Front wheel drive, Low & high gear ratio, universal joint and propeller shaft.

Final Drive & Drive Shafts: Differential carriers double reduction gearing, differential lock, crown wheel and pinion adjustments, function and types of power take off (PTO) mechanism. Types of front & rear axles. Common trouble and their remedies, care and maintenance.

Steering & Suspension Systems : Function and types of steering system. Description, construction and function of mechanical steering system steering wheel, steering gear box, tie-rod, arms link, ball and socket joints etc. Their movement and adjustment. Description and mechanism of foot steerage pedal as incorporated in tractors. Description, working and principle of hydraulic steering system. Different parts such as pump, distributor valves, pipe line and hoses etc Development of mechanical framing. Use of Power tiller, Tractor & Bulldozer, Chassis frame of tractor.

Wheels & Tyres: Description, construction and function of Wheel. Rim sizes. Types & sizes of tyres. Solid, pneumatic & Radial. Ply rating. Tyre materials, Hysteresis & designations, Tyre information, Tyre tread designs, Tyre ratings for temperature & traction. Importance of in-Flatting tyres to correct pressure. Repair and maintenance of tyres and tubes. Storage of tyres. Descriptions Tirewear Patterns and causes Nitrogen vs atmospheric air in tyres

Braking Systems: Braking fundamentals Principles of braking, Drum & disc rakes, Lever/mechanical advantage, Hydraulic pressure & force, Brake fade.

Braking systems : Brake type used on tractor - principles, Air brakes,

Braking system components : Park brake system, Brake pedal, Brake lines, Brake fluid, Bleeding, Master cylinder, Divided systems, Tandem master cylinder, Power booster or brake unit, Hydraulic brake booster, Applying brakes, Brake force, Brake light switch

Drum brakes & components : Drum brake system, Drum brake operation, Brake linings & shoes, Backing plate, Wheel cylinders

Disc brakes & components : Disc brake system, Disc brake operation, Disc brake rotors, Disc brake pads, Disc brake calipers, Proportioning valves, Proportioning valve operation, Brake friction materials.

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.

Tractor equipment : Description, function of harrows, cultivators, seed drills & tractor trailer. Hitching of equipment. Danger in overloading & incorrect field operation. Average life of Agriculture implements. Description and function of tractor accessories such as Draw bar, top link & Belly Pulley. Setting of draw bar to correct height. Use of Hydraulic lift. Maintenance of tractor accessories.

Tractor Electrical Maintenance : Lighting arrangement in tractors (As applicable). Description of charging circuit. Operation of alternator, regulator unit ignition warning lamp troubles and remedy in charging system. Fault finding in electrical system.

Description of starter motor circuit : Common troubles and remedy in starter circuit. Description of lighting circuit. Charging & discharging of lead acid battery.

Module – 5th **(10 Marks)**

15.Primary Tillage Implements and Soil Forming Equipments

Types of tillage & their uses : Working principles of ploughs. Constructional details. Workshop adjustments. Method of hitching. Importance of weight transfer. Considerations while using mounted and semi mounted implements. Method of ploughing. Methods of field operation. Recommended speeds for operation under different field conditions. Daily and periodical maintenance

Function & working of :Sub soiler/ chisel plough. Constructional details. Function & working of Rotavator. Workshop adjustments. Method of hitching. Importance of weight transfer. Method of ploughing. Method of Field operation. Recommended speeds for operation of rotavators. Daily and periodical maintenance

Types of harrows & their uses: Working principles& Constructional details. Setting and adjustments. Hitching and mode of operation. Difference between disc harrows & drag harrow. Difference between disc harrows & disc plough. Trouble shooting. Safety precautions.

Types of cultivator: Working Principles & their constructional details, adjustments.
Common types of shovels & seeps. Adjustments, mode of operation. Trouble shooting. Care & Maintenance. Soil forming equipment & their types. Constructional details of levelers, scrapers/ blade terracer, ditchers and bund formers. Constructional details of Lazer leveler, trencher & dozer/dumper and post hole digger. Prime mover & driving practice. Adjustments, mode of operation. Method of Field operation. Recommended speeds for operation.

Module – 6th **(10 Marks)**

16. Secondary Tillage Implements and Irrigation Pumps

Types of seed drills & their uses : Constructional details of seed cum fertilizer drill. Seed & fertilizer metering devices. Constructional details of special drills such as zero till, strip drill/rotto drill & Happy seeder. Types of furrow openers, methods of transmission of power. Calibration & workshop adjustments. Field calibration and mode of operation. Guide chart for mixing fertilizers. Recommended speeds for operation. Care & maintenance

Types of planters : Constructional details of Maize, Cotton, G/ nut & potato planters . Constructional details of paddy transplanter, Sugarcane & paddy transplanter. Common metering devices. Types of furrow openers. Power transmission. Function of row marker. Field operation of paddy transplanter. Field
operation of veg. transplanter. Use of cage wheels and puddles.

Types of fertilizer applicators : Constructional details of fertilizer applicators Types of furrow openers, Methods of transmission of power. Calibration & workshop adjustments. Field operation & adjustments of fertilizer applicators. Recommended speeds for operation Care & maintenance.

Source of water: Study common irrigation and drainage systems. Types of irrigation systems. Types of pumps. Working principles & constructional details of centrifugal pumps.

Types of centrifugal pumps : Constructional details & principle of operation of a submersible pump. Description of tools and equipment required for boring a tube well. Use a compressor for revitalizing the tube well to improve its discharge. Pump selection, common prime movers, and coupling devices. Different types of irrigation pipes. Working principles of valves and hydrants. Working principles of Popup/sprinkler & mister /fogger. Working principles of drippers. Methods of field operation & adjustment.

Types of power tillers, their uses : Constructional details. Method of power transmission for different field operation with different attachments. Common types of weeds and their control. Methods of weed control. Constructional detail of power weeder. Premergence and post emergence applications. Recommended weedicides for different crops. Equipments used for their applications.

Harvesting Machines

Types of electrical motors : Used on the farm their constructional details, selection, operation, care and maintenance. Different types of starters. Fuses and their capacities. Installation of motors. Safety precautions Types of sprayers & dusters. Working principles. Calibrations of sprayers & dusters. Method of operation. Common prime movers. Workshop adjustments. Constructional details, working principles & calibration of high clearance sprayers/ cotton & Aero blast sprayers. Methods of operation.

Reapers & their types Functions : Working principles, constructional details. Field adjustments & operation Care and maintenance. Trouble shooting. Precautions in working & transporting.

Types of threshers : Maize Sheller and ground nut decorticators. Working principles, constructional details. Adjustments and operations. Prime mover and driving systems. Trouble shooting and remedies. Transmission of power belts and pulleys.

Purpose of a combine harvester: Advantages and limitations. Types of combine harvester. Special purpose combine harvesters. Working principles & constructional of different systems of combine harvester. Components of different systems of combine harvester. Flow path material of combine harvesters. Power

transmission & drive systems. Workshop adjustments. Methods of field operation. Field adjustments according to crop & soil condition. Types of grain losses, their causes and remedies.
Factors affecting the performance of a combine. Recommended speeds. Considerations while selecting a combine. Custom hiring of combine. Calculating of
combine operation of combine harvesting. Safety precautions.

Need of green harvesting equipment : Working principles, constructional details of
mover. Functions, working principles, constructional details of folder harvester. Functions, working principles, constructional details power chaff/ silagecutter. workshop and field adjustments. Methods of field operation. care and maintenance. Function and working of rotary harvester. Function and working of hay-bailer. Workshop adjustments. Method of field operation. Method of transportation. Common accidents and their prevention. Trouble shooting. Care and maintenance.

Need & importance of root harvesting : Machine. Types & working of diggers. Components of diggers. Prime mover attachments and driving system. Transporting the root harvesting machinery. Settings & Adjustments.

Module – 7th

17. Seed Processing Machines **(10 Marks)**

Important of winnowing : Types of winnower and its parts. Importance of cleaning & grading. Types of cleaner/ grader. Methods of cleaning/grading. Prime mover attachments and driving system. Settings and Adjustments. Troubles & maintenance. Safety precautions.

Importance of rice huller and polisher : Feed grinder-cum-mixer, hammer mill, oil extractor and sugarcane crusher. Constructional details, materials used. Principles of operation. Common faults and remedies.

Working of fans and blowers : Purpose of grain auger, bucket elevator etc., Constructional details and working of a grain drier. Grain storage structure i.e. concrete and sheet metal bins (sylo structure). Methods and instruments used for measuring

moisture contents of grains. Equipment and methods used for treating and fumigating seeds and grains.

Operation of transporting and handling : Equipment i.e. Tractor, tractor trailer, power tiller & combine harvester.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.

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