A COURSE OUTLINE

IN

AGRICULTURE MECHANICS

FOR

TECHNICAL INSTITUTIONS

IN

GUYANA

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COURSE TITLE : Agriculture Mechanics

LEVEL : Craft Certificate

PRE-REQUISITE : The requirement for the course are:

- Complete at least five years secondary education.
- G.I.T.C- Competency Certificate P.M.T.C – Basic Craft in Agriculture Mechanics.
- Age: G.T.I/N.A.T.I – 16 years and over for full time students.
- G.T.I/N.A.T.I – 18 years and over for evening classes and working the appropriate area of studies.
- P.M.T.C./G.T.T.C. (Apprentice) 15 years to 17 years.
- Preference will be given to students with Mathematics. (G.C.E/C.X.C) or an appropriate Science subject with special preferences to Agri. And Engineering Science.

COURSE PURPOSE : The course provides a broad based coverage of principles and techniques and is relevant to both light and heavy vehicles. The knowledge and experience gained would develop and the ability of students to effectively test equipment with tools while working on trouble shooting.

COURSE DESCRIPTION : Subjects

- Practical (I.C.E., transmission and implements)
- Technology – (Power units)
- Power transmission
- Engineering Science
- Calculations.
- Workshop process and materials
- Agriculture Machinery
- Agriculture Science/Crop Husbandry

- Machine shop practice and welding
- English and Technical reporting writing

COMPETENCY PROFILE

Technology (Power unit)

- Know workshop regulations and safety precautions.
- Apply and practice health and safety procedures relevant to the course of study.
- Know how the Internal Combustion Engine operates
- Examine different types of engine construction.
- Examine and assemble cylinder heads.
- Determine how the poston and rings form a seal.
- Examine connecting rod and bearings.
- Explain the use and construction of crank shafts
- Explain the co-ordination between crankshaft and value timing.
- Outline the importance of lubrication.
- Explain the importance of installing a cooling systems.
- State the importance of clean air supply.
- Explain the need for fuel system and combustion.
- Describe the Petrol Ignition System.
- Display a knowledge of Fuel Injection Pumps and their operation.
- Explain the operation of the Turbocharger and supercharger.
- Describe cold starting aids and correct any faults.
- Explain the importance of batteries.
- Compare and describe the operation of the coil ignition system and the magnet system with sketches.
- Discuss the effects of a faulty condenser on engine performance.
- Explain the importance of a distributor in the engine.
- Discuss the materials used for the contact breaker points.
- Discuss the construction of a spark plug.
- Display knowledge of charging system.
- Outline the importance of principles governing transistorized ignition system.

POWER TRANSMISSION

- Display a working knowledge of clutches.
- Describe the operation and correct faults in a gear box.
- Discuss and describe the final drive.
- Show knowledge and universal joints and propeller shaft.
- Describe and display knowledge of brakes and master cylinders.
- Display and describe working knowledge as regards wheel and track alignments and adjustments.

CROP HUSBANDRY

- Outline the importance of soils in Agriculture in relation to Agri. Machinery.
- State the importance of climate and other factors on land use, capabilities and classification.
- Explain the effects and control of soil erosion.
- Discuss importance factors in crop cultivations as it relates to Agriculture Mechanics
- Discuss the importance of maintaining soil fertility.
- Display a general knowledge of flowering plants.
- Describe and discuss plant reproduction processes.
- Describe and discuss the importance of drainage and irrigation used in Agriculture.

AGRICULTURE MACHINERY

- Outline the use and importance of ploughs.
- Explain the principles governing harvesting equipment and used in farming.
- Give evidence of knowledge in the identification, use and care of spraying equipment.
- Distinguish between the different types of cultivators and state how cultivators are operated and maintained.
- Explain the importance and use of fertilizer equipment.
- Explain the operational procedures and installation of dairy equipment.
- Explain the operation, care and maintenance of planting equipment.
- Explain the operations of grass cutting equipment.

- Outline the types, importance and functions of hitches and linkages.

INSTRUCTIONAL TECHNIQUES

a. Visual Aids - sectioned components instructional
b. General workshop facilities (engine)
c. Tools and equipment.

ASSESSMENT/EVALUATION

End of year test and final year examination (G.T.E.E) G.T.I/N.A.T.I. – 80% attendance for every term. Must have course work, 25% of total (i). Home work (10%)
(ii) Class work (10%)
(iii) Projects (5%)

End of year test and final year examination (G.T.E.E)

Final Examination (G.T.E.E.)

G.T.I/N.A.T.I: - Theory (including Practical)

(Power unit, transmission and implements).

Grading:

0 - 44	- Fail	(F)
45 -59	- Pass	(C)
60 - 79	- Credit	(B)
80- 100	- Distinction	(A)

TECHNOLOGY (Power Unit)

1. **Introduction: Know workshop regulations and safety precautions**.
   (i) List the general workshop regulations.
   (ii) Explain the basic safety precautions.
2. **Health and Safety**

Apply and practice health and safety precautions

1. Outline the basic principles of accident preventions.
2. List the general causes of accidents.
3. Show the importance of personal protection and cleanliness.
4. Explain the use of safety on machinery and equipment.

5. Define flammable, poisonous liquids and gases.
6. List the basic fire fighting equipment.
7. Show the precautions of electrical safety and harmful substances.

NOTE ON SAFETY

Safety and safe practice should form and integral of all instructions.

3. Internal Combustion

Know how the engine operates

1. Sketch and explain the operation of the four stroke and two stroke cycle.
2. Compare the operation of the spark ignition and compression ignition engine.
3. Calculate compression ration, swept and clearance volume using; $\underline{Cr = SV+CV}$ CV

4. Engine Construction

Examine different types of engine.

1. Show the construction of the mono-block and multi-block
2. List the materials used in block construction.
3. Compare and describe the wet and dry liners.
4. Describe the needs for proper location and sealing.
5. List the reasons for the use of more than one cylinders.

5. Cylinder Head

Examine and assemble cylinder heads.

1. List the reasons for choice of materials.
2. Discuss the importance of correct tightening sequence.
3. Investigate the importance of gaskets.
4. List the effects of worn and unclean gasket.

6. **Piston and Piston Rings**

Determine how the piston and ring forms a seal.

1. List and sketch the types and reasons for different piston crown.
2. Explain and discuss piston skirts design.

3. State the types and purpose of ring.

4. List the materials used in piston ring construction.

5. List the materials used in the construction of piston liners.

6. List the materials used in the construction of wet and dry liners.

7. List the various methods of removing Gudgeon pin.

8. Sketch and explain each method.

7. Connecting Rod and Bearings

Examine connecting Rod and Bearings

1. State the materials used in crankshaft construction.

2. List the common types of crankshaft.

3. State the importance of correct firing orders.

4. Discuss bearing arrangements on crankshaft as it relates to construction.

5. List the types of bearing materials used on crankshaft journals.

6. Show the importance of adequate lubrication.

7. Sketch the arrangements of oil seals and their importance.

8. State the functions of the flywheel.

9. Explain the need for vibration dampers.

8. **Crankshaft and Valve Timing**

Explain the coordination between the two

1. State the materials used in crankshaft construction

2. Investigate the importance of cam profile.

3. State the methods of valves operation

4. Sketch and describe the operation of the methods.

5. Sketch each of the following in relation of valve operation: tappets, push rods, rocker shaft, rocker arm, valve and valve seats, valve guides and valve springs.

6. Sketch valve timing diagrams.

7. Explain the reasons for correct valve timing and its importance.

9. Lubrication
Outline the importance of lubrication.

1. Discuss the properties of lubricants.

2. Explain the purpose of the lubrication system.

3. Define splash, mist and pressure feed lubrication system.

4. Explain with sketches the operation of oil pumps.

5. With the aid of diagrams discuss the operation of pressure relief valve.

6. List the difference between full-flow and by-pass filtration systems.

7. Highlight the importance of oil filters in the systems.

8. Explain with sketches the wet and dry sump lubrication systems.

9. State the reasons for using additive in oils.

10. Diagnose and rectify faults in the lubrication systems.

10. Cooling System
Explain the importance of the installation of the systems.

1. Explain the necessity for cooling.

2. Describe and compare liquid and air cooling (water and oil).

3. List the disadvantages of the thermos syphon in the as against the force feed system.

4. Emphasis the importance of correct pressure in the cooling system.

5. State the reasons for installing thermostats in the cooling system.

6. Diagnose and rectify faults in the cooling system.

11. Air Supply

State the importance of clean air supply

1. Discuss the function and construction of the various types of (oil bath and paper element).

2. Show the importance of servicing air cleaner.

3. State the effect of dirty, restricted and faulty air supply.

12. The Fuel System and Carburetion

Explain the need for fuel system and combustion

1. Outline and illustrate the layout of a typical fuel system.

2. Describe and compare the need of electrical and mechanical fuel lift pumps.

3. State t he composition and combustion of petrol.

4. Explain with sketches the principle and action of the simple calorimeter with aid of diagrams.

5. List the effects of mixture strength or the combustion process and their effects on engine performance.

13. Petrol Ignition System

Describe the Petrol Ignition System

1. Sketch the layout petrol injection system.

2. Define the principle of the continuous and impulse types with sketches.

3. Diagnose and rectify faults in the petrol injection system.

14. Fuel Injection Equipment

Display a knowledge of fuel injection pumps and their operation

1. Compare the direct combustion chamber as against.

2. Explain the principle of operation of the fuel injection system.

3. Discuss the combustion processes.

4. Sketch and explain t he operation of different types of nozzle.

5. List the effect of a faulty nozzle on engine performance.

6. Sketch the describe the principles of operation of the inline and distributor type fuel pumps.

7. Recognize the importance of correct calibration spill-timing and phasing of pump (injection).

8. Explain the operation of the mechanical pump.

9. Distinguish between the rotary and in-line pump.

10. State the types of fuel used in compression ignition engine.

Turbocharger and Supercharger

Explain the operation of turbocharger and supercharger.

15. Cold Starting Aids
Describe cold starting aids and correct any faults.

1. State the necessity for cold starting aids.

2. Discuss the types in common use.

3. Diagnose the rectify common faults.

16. Electrical Systems

Batteries

Explain the importance of batteries

1. Describe the operation of a simple lead acid cell
2. Show the methods of construction.
3. Realize the importance of care and maintenance.
4. Diagnose and rectification of common faults.

17. Coil ignition and magneto ignition system

Compare and describe the operation of coil ignition system and the magneto ignition system with sketches.

Condenser
Discuss the effects of a faulty condenser on engine performance.
Distributor

Recognize the importance of a distributor in the engine

1. State the purpose for installation in the ignition system.
2. Recognize the importance of correct timing of the distributor on engine performance.

Contact Breaker Points
Discuss the materials used for construction of contact breaker points

1. State the effects of too large and too small a clearance in the system.

2. Recognize the effects and importance of dwell angle on engine performance.

Spark Plugs
Discuss the construction of a spark plug.

1. Recognize the importance of proper selection of plugs
2. State the care needed in spark plugs.

18. Starting Systems

Understand how the engine operates.

1. Outline and illustrate the layout of a typical starting circuit.
2. Sketch the in-board and out-board starter device.
3. List they types of starter solenoids.
4. Describe and compare the two types of starter device.

19. Charging Systems
Display knowledge of charging systems.

1. State the principle of operation of the D.C. generator.
2. State the principle of operation of the A.C generator.
3. Distinguish between the two by circuit diagrams.
4. Explain the need for a cut-out (voltage regulator).
5. State the construction of the cut-out by diagrams.
6. Highlight the importance of correct adjustments.

20. Transistorized Ignition System
Outline the importance of and principles governing Transistorized Ignition System.

1. Outline and illustrate the layout of a typical transistorized ignition system.
2. Explain the principle of operation of the transistorized ignition system.
3. Test the system for proper functioning.
4. Diagnose and rectify faults in the transistorized ignition system.

Power Transmission

1. Shafts
   Keys and keyways; inspection of key fits, spring and serrated hubs and driving flanges.
2. Pulley drives
   Flat and vee pulley drives; fitting of belts, inspection of belt drives.
3. Gears
   Common types of gear teeth? Simple gears trains including constant-mesh shifting gears. Gear-shift linkages, such as selector shaft and forks.
4. Chain and Sprockets
   Common types of chain; installation and adjustment of chain drives; chain lubrication; chain and sprocket inspection.
5. Ball and Roller Bearings
   Common types and their uses; cleaning and inspection; removal and assembly; lubrication.
6. Bush and Shell Type Bearings
   Common types including self-lubricating bearing, materials used; cleaning and inspection; removal and assembly lubrication.
7. Seal Elements.
   Seal rings, metallic and non metallic oils. Materials used, application gaskets, dirt excluders.

Power Transmission

Clutches
Display a working knowledge of clutches

1. The construction and operation of the coil spring and diaphragm spring clutches by sketches.
2. Discuss the driven plate construction
3. Explain the types of materials used in the construction of driven plates.
4. State the advantages of multi-plates clutches with reference to wet and dry clutches.
5. Explain how disengagement is achieved in both mechanical and hydraulic clutches.
6. List the importance of correct adjustments for clutches.
7. State the principle of operation of the torque convertor.
8. Explain the operation of the automatic transmission with sketches.
9. Diagnose and rectification of faults.

Gear Box
Describe the operation and correction of faults in gear box.

1. State the reasons for a gear box.
2. Explain the principle of operation of the three speed and four sliding pinion gear box.
3. State the advantages of the constant mesh gear box against the sliding mesh gear box.
4. State the importance of the synchromesh unit in gear boxes.
5. State the reasons for selector mechanism.

6. Identify the principle wearing parts and lubricants used.
7. State the principle of operation of the automatic gear box with sketches.
8. Trace smooth engagement and disengagement.
9. State the materials used in the manufacture of gears.
10. Recognize the need for auxiliary gear boxes and transfer gear boxes.
11. Diagnose and rectify common faults.

Final Drive
Discuss and describe the final drive

1. State the reasons for the final drive gears.
2. Identify different types of final drive gears.
3. Reasons for double reduction drives.
4. State the importance of correct adjustment..
5. Discuss the position of oil seals used.
6. Explain and sketch the principle and operation of differential unit.
7. Diagnose and rectify faults.

Universal Joints and Propeller Shaft.
Show knowledge of universal joints and propeller Shaft.

1. List the different types of coupling used to transmit a drive.
2. List the advantages and disadvantages of each type.
3. Discuss the torque tube arrangement.
4. List the methods of supporting drive shafts.
5. List the importance of lubrication on the smooth functioning of the shaft.
6. Explain reasons for proper installation of shafts.
7. Diagnose and rectify faults.

Brakes, Wheels and Master Cylinders
Describe and display knowledge of brakes and master cylinders.

1. Outline the action of a simple braking system.
2. Define the types of breaking system (DRUM & DISC).
3. Compare the two systems and sketch their operation.
4. List the different types of adjusters.
5. State the types of friction lining used.
6. Define the purpose of mechanical brakes with compensators.
7. List the requirements of a brake fluid.
8. List the importance of correct bleeding procedures.
9. Explain and sketch the master cylinder.
10. Show the importance of static and dynamic wheel balancing.
11. Diagnose and rectify fault in the system.

Crop Husbandry for Agriculture Mechanics Craft Level.

1. **Soil**

Outline the importance of soil in Agriculture

1. Definition of soil.
2. Outline different types of soil and their composition.
3. Explain soil origin and formation.
4. List common soil characteristics.
5. Outline the importance of the living population of the soil to both plant and soil development.
6. Explain the reasons for carrying out soil conservation practices.

2. **Land Use**

    1. Definition of climate.
    2. Explain the causes of rainfall, how it is measured, its seasonal distribution and its effect on plant growth.
    3. Definition of temperature, its measurement and effects on plant growth.
    4. Explain the effects of light intensity on plant growth with respect to day light hours and day length.

3. **Soil Erosion**

Explain the effects and control of soil erosion.

1. Definition of erosion**.**
2. Explain the causes for the various types of erosion.
3. Discuss the effects of erosion on the soil and plant growth
4. Explain the various erosion control methods.
5. Discuss the reasons for grouping soils to form planting systems.

4. **Cultivation**

Discuss important factors in crop cultivation as related to Agriculture Mechanics

1. List the various factors that affects cultivation.
2. Discuss the methods of drainage and irrigation, high lighting their importance with respect to crop growth.
3. Description of various methods of drainage.
4. Explain the aim of primary tillage operations.
5. State the factors that determine the correct time for carrying out cultivation practices.
6. Explain the aim of seed bed preparation.

5. **Soil Fertility**

Discuss the importance of maintaining soil fertility.

1. Explain why soil fertility must be maintained.
2. Describe the various ways how soil must be maintained.
3. Discuss the application of both organic and inorganic fertilizer to growing crops.

4. List the major and minor plant nutrients and state the functions of each.
5. Discuss the composition of origin of fertilizer.

6. Plant Life and Growth
Display a general knowledge of flowering plants

1. Discuss the classification of flowering plant based on their length of life.
2. Sketch the various parts of flowering plants.
3. List the factors affecting growth and development of plants.
4. Distinguish between annual and woody perennials.
5. State and describe the methods of weed control for the successful growth of plant.

6. Plant Reproduction

Describe and discuss plant reproduction processes

1. Explain the various types of reproduction processes.
2. Describe the advantage and disadvantages of each reproduction processes.
3. Describe how crops can be propagated vegetatively.
4. Discuss methods of seed dispersal.
5. Discuss in detail the production of two named crop under the following headings.
   i. Method of propagation
   ii. Tillage operations
   iii. Husbandry practices.
   iv. Harvesting and processing

Agriculture machinery for Agriculture Mechanics – Craft Level

1. Ploughs
Outline the use and importance of ploughs

1. Describe the various types of ploughs and give their function.
2. With the aid of sketches describe the various parts of mould board, disc, chisel and reversible ploughs.
3. Explain the advantages and disadvantages of each of the plough.
4. State the functions of the various parts of each plough.
5. Explain the necessary operational adjustments to be carried out on each plough.
6. List the various plough faults and say how they can be rectified.
7. Explain the maintenance procedure for ploughs at the beginning and end of erosion.

2. Harvesting Equipment (Grain and Harvesting Machinery)
Explain principles governing harvesting equipment

1. Describe the working principles of threshers and trailed and self propelled combines and their advantages.
2. Explain the functions of the various parts of the combine with the aid of sketches.
3. List the operational adjustments to be carried out to the harvester
4. With the aid of a diagram trace the crop flow through the harvester.
5. Explain the maintenance procedure for combine at the beginning and end of season.
6. Explain how grain losses and cracked grains are cause and say how they can be rectified.
7. Identify and explain the need for safety devices in the combine harvester.

3. Sprayers
   Give evidence of knowledge in the identification, use and care of spraying equipment.

1. Explain the working principles an construction of main types high, medium and low volume sprayers.
2. Define each form of liquid used in sprayers:
   i. Solution
   ii. Emulsion
   iii. Solvent
3. Produce sketches to show liquid flow circuits in Spray on, Suck back and Neutral
4. Identify nozzle components and the advantages of the various nozzles used.
5. Explain the functions of the various parts of the sprayer.
6. List the various types of pumps used on sprayers and explain their operation.
7. Explain why the calibration of sprayers is necessary and discuss the various methods used.
8. Explain the various maintenance procedure to be carried out at the beginning and end of season.
9. Safety precautions that must be taken when using sprayers.

4. Cultivation
   Distinguish between different type of cultivations and state how cultivators are operated and maintained.

1. Describe the working principles of rotary cultivators, disc harrows and tined cultivators.
2. With the aid of sketches explain the functions of the various parts of the cultivations.
3. State the operational adjustments to be carried out on cultivators.
4. Explain the various maintenance procedure to be carried out at the beginning.

5. Fertilizer Equipment
   Explain the importance and use of fertilizer equipment.
1. Explain the working principles of the main types of fertilizer distributors.
2. Explain how the feed rates can be altered on fertilizer distributors.
3. State and describe the common types of distributors mechanisms.
4. Explain the need for calibration and say how it can be carried out.
5. Discuss the operational adjustments that has to be made on distributors.
6. Explain the maintenance procedures to be observed at the beginning and end of the season on distributors.

6. Diary Equipment and Installation
Explain the operational procedure and installation of diary equipment.

1. Explain the construction and working principles of milking machines.
2. With the aid of sketches explain the functions of the various parts of milking machines.
3. Explain the operational adjustments to be carried out on milking machines
4. List reasons to say why milk must be cooled before being placed in aluminum churns.
5. Explain the maintenance procedures to be observed at the beginning and end of each milking session.

7. Planting Equipment
Explain the operation, care and maintenance of planting equipment.

1. Explain the operation and construction of seed drills including planters.

2. With the aid of sketches explain the functions of various components of seed drills and planters.
3. Explain the need for calibration and say how it can be carried out.
4. State the operational adjustments to be carried out on seed drills and planters.
5. Explain the maintenance procedure to be observed at the beginning and end of the season.

8.**Grass Cutting Equipment**
Explain the operations of grass cutting equipment.

1. Explain the operation and construction of mowers and rotary slashes.
2. State the function of the various parties of the mower and rotary slasher.
3. Explain the preparation procedures for mowers and rotary slashers before and after season.

9.**Hitches**
Outline the types, importance and functions of hitches.

1. Define the types of hitches.
2. Discuss the importance of correct hitch adjustments.
3. List the advantages and disadvantages of too high and too low hitch points.
4. With the aid of a diagram show the layout of the three point linkage.
5. List the types of top link and stabilizer bars.
6. State the purpose of alternative linkage positions.

Workshop Processes
1. Define the following terms

a. Ductility
b. Hardness
c. Malleability
d. Elasticity
e. Strength
f. Fatigue
g. Case hardening

2. Ability to carry out the following test

a. Hardness
b. Annealing
c. Case hardening

3. Ability to distinguish the Physical and Chemical properties of Commercial Metals in their pure state.

a. Copper
b. Tin
c. Lead
d. Zinc
e. Cast iron
f. Steel

4. **Carry out repair processes of materials such as**

    a. Common solders
    b. Alloy steels
    c. Light alloys
    d. Cutting tool material

5. **Carry out repairs pertaining to the use of the following.**
    a. Plastics b. Thermosetting c. Thermoplastics d. Rubber
    d. Other non-metallic materials

6. **Distinguish the basic properties of a good bearing metal, and their use in Agriculture Machines and workshop equipment.**

7. **Define the term 'Corrosion'**
    Identify ways in which corrosion can be prevented.

COMPETENCY PROFILE FOR MACHINE SHOP PRACTICE STUDENTS SHOULD BE ABLE TO:

1. Use and care (include storage) of hand tools including spanner, screw drivers, reamers, taps and dies, saws, chisels, punches, hammers, pullers and stud extractors.

2. Care and correct use of the steel rule, calipers, dividers, square, straight edge and protractor. Read precision measuring instruments including micrometer Vernier, dial gauge and thread gauge.

3. Understand principles of metal cutting, chip formation, importance of tool shape, rake and clearance angle. Calculate cutting speed for common materials; understand the correct use of Jigs and Fixtures.

COMPETENCY PROFILE FOR POWER TRANSMISSION

1. Students should be able to:

i. Adjust fan belts
ii. Inspect and repair same
iii. Adjust and check chain drivers
iv. Inspect bearings for wear and make recommendation
v. Remove, inspect and replace bearings and bushes
vi. Cut gaskets and make joints
vii. Remove and replace oil seals

AGRICULTURE MECHANICS

WORKSHOP PRACTICE

4. MATERIALS

1.

General properties of materials such as ductility, hardness, and natural case of working related repair process and typical uses in agriculture machinery.

2.

Use of the commercially pure materials, tine, lead, zinc. Copper and aluminum in the construction of agriculture machinery and for protective coatings. General properties and basic composition, related to typical uses, of plain carbon steels, malleable cast iron, wrought iron, brass and bronze. Standard forms of supply. A brief view, in relation to repair processes and performance, of material such as common soldiers, alloy steels, light alloys and cutting tools materials. Plastic (thermosetting and thermoplastic), rubber and other non-metallic materials in common use in agriculture.

3.

An outline of the basic properties of a good bearing metal. Common bearing metals and their uses in agricultural machinery and workshop equipment. Causes and results of corrosion. Preventative and protective measures such as inhibition, surface treatment and protective films including a brief review of electro-deposited coatings. Special steel and other alloys employed for corrosion resistance; their limitations in machinery and welding.

4.

Fitting. Use and care (including storage) of common hand tools including spanners, screw drivers, reamers taps and dies, saws, chisels and punches. The proper use of these on typical repair and replacement work.

5.

Measurement. Care and correct use of the steel-rule; calipers, dividers, STRAIGHT EDGE and protractor. Use of gauges for angle, thickness wire, drill, and thread size.

Identification of materials by simple practical methods including fracture, bending, hardness and spark tests, use of a normal range of hand tool for cutting. Fitting and measuring (including the micro meter).

Marking out and layout on sheet, plate, castings, forgings, and components in preparation for machining or fabrication. Soldering of electrical joints.

MATHS AND SCIENCE

Students should have the ability to solve problem related to:

1. Fractions
2. Ratio and proportion
3. Averages
4. Percentages
5. Decimals
6. Mensuration
7. Logarithms
8. Trigonometry – use of Pythagoras Theorem
9. Indices
10. Transposition of Formulas

Science – Heat

Students should have the ability to solve problems related to heat, temperature, expansion the state of matter. Have the ability to read the micro-meter. Student should have the ability to read P.H chart. Have the ability to read thermometer and the ability to convert from one scale to another; to perform simple experiment pertaining to conduction, convection and radiation.

1. Mechanics

Identify simply levers – calculate leverage with reference to vehicle application – ability to calculate mechanical advantage, velocity ratio and efficiency. Calculate simple gear train ratio. Have the ability to solve simple problems based on beld and pulley drives – chain drives – revolution per minute and peripheral speeds.

2. Centre of Gravity

Define and determine centre of gravity and stability; calculate centre of gravity – definition of force and moments – calculating force and moments. Application of forces on vehicle – application of forces on gear drives. Define torque – solving problems based on torque.
Define Power. Horse power, break horse power. Break mean effective pressure – solving problems relating to same a simple hydraulic circuit and solving problems relation to same.

Friction

Define friction – state the laws of friction – calculation of simple problems relation to same. Define acceleration, retardation and solve simple problems relating to same. Have the ability to calculate density, specific gravity of solids and liquids – must be bale to elate between force, area and pressure.

Electricity

Ability to define terms as volts, ampere, watts, resistance – electro-motive-force. Ability to design simple series and parallel circuits and solves problems relating to them. Define the effects of an electric current. Ability to read simple colour coding – ability to explain insulators-conductors, fuse, primary and secondary wires.

AGRICULTURAL MECHANICS

CALCULATIONS AND SCIENCE

3. CALCULATIONS

1.

Practical calculations involving the use and manipulation of fractions simple formulae averages, ratio and percentages. Common English and metric measures an conversion. Measurement of simple plain figures and solids. Simple land measurement.

SCIENCE

2. **HEAT**

Nature of heat. Temperature quantity of heat. Measurement of temperature by thermometers. Effects of heat, expansion and change of state with special reference to the internal combustion engine. Water vapour in the atmosphere. Simple treatment of humidity. Conduction, convention and radiation and their practical applications.

MECHANICS

3.

The lever. Principle of levers. The meaning of mechanical advantage and velocity ratio. Introduction to pulley and gear ratios. Relationship between r.p.m. an peripheral speed. Pulley, gear, belt and chain drives.

4.

Centre of gravity; connection between centre of gravity and stability and it importance in the safe loading and handling of tractors and equipment. The difference between force and pressure. Simple idea of the hydraulic press as applied to hydraulic systems in agricultural tractors.

5.

Simple treatment of the difference in friction between dry and lubricated surfaces, examples of useful and wasteful friction e.g. clamping devices, drives and bearings.

6.

Effects of an electric current; heating, chemical, magnetic, electrical. Supply as a source of energy, practical units fuses their purposes and rating. Simple circuits, conductors, insulators, resistance, colour coding, cells-primary and secondary.

COMPETENCY PROFILE FOR METAL WORK AND WELDING

Outline Workshop Safety Practices

Ability to discuss and outline the safe use of oxy-acetylene and electric arc welding. Identify the correct type of safety wear – discuss and describe the value of observing safe workshop practice keeping and work habits. Discuss and illustrate the principle of oxy-acetylene welding.
Illustrate and examine the various welding method. Illustrate the various methods of welding pipes. Examine and illustrate the complete procedure of welding; ferrous and non-ferrous methods.

Arc Welding

Discuss and illustrate the principle of manual shielded arc metal welding – examine and illustrate the various welding methods. Illustrate the various methods of welding pipes. Examine and illustrate the complete procedure of welding various ferrous and non-ferrous methods. Describe the oxy-fuel gas cutting and gouging processes. Examine and illustrate the principle of various oxy-fuel gas gouging process. Examine and illustrate the use of various equipment used for cutting and gouging various kinds of metal work. Examine and illustrate the complete procedure of cutting and gouging various kind of metals describe the various electric arc cutting process. Examine and illustrate the principle of operation cutting using other electric arc process.

METAL WORKING AND WELDING

Working of strip and bar bending, twisting, upsetting and drawing down using the forge or furnace and smith's tools. Hot riveting operations as in the assembly of the disc coulter hot bending of pipe. Oxy-acetylene and arc welding of the following types of joint in mild steel, (joints may be test pieces or include in practical fabrication.)

Prepared edge butt up to ½" thickness.
Butt joints in square or round bar up to ¾ diameter. Inside and outside corner joints and lap joints on materials, up to ¼ thickness.
Building a pad or worn section up to ¼" thickness. Simple pipe welding. Oxy-acetylene welding of thin sheets. Oxy-acetylene cutting, flame cleaning and heat and gouging e.g. for the removal of rivet heads. Bronze welding of malleable and galvanized parts. Hard metal deposits on wearing surface e.g. start or welding on of a new lip.

METAL WORKING AND WELDING

6. Use of vee blocks, angle plates, and associated equipment, for making out in preparation of fitting, machining and cutting to shape.

7. Construction, care and use of micrometer, venire and dial gauge instruments. Typical measuring and setting up operations in overhaul and repair work and in machining. Proportions and simple workshop measurements of threads commonly used in agricultural machinery. Introduction to the use of a limit system with reference to the primary selection of fits according to an accepted standard (e.g. British Standard Specification 1916). Use of plain gap and gauges.

8. Sheet metal working, tools, equipment, and methods used for the bending of simple forms, including lapped, wrapped and welded joints.

9. Development of simple shapes form one sheet including the cone and pyramid. Layout to secure economical use of material.

10. Heat-treatment and hot working. A simple account of the heat treatment of plain carbon steel including the temperature and methods used for hardening, tempering, normalizing an stress-relief. Effect and avoidance of over-heating and oxidation during heat treatment and hot working. Importance of temperature control. Methods used for typical hot working, operations; bending twisting straightening, upsetting, drawing-down and riveting. Forge – welding and its uses.

11. Metal joining. Soldering and brazing fluxes and filler metals in common use, application to typical mechanical and electrical work.

12. oxy-acetylene welding. Storage handling and safety in the use of a gap welding equipment. Choice of equipment and principles of operation. Preparation and setting up welding procedures for common use, application of welding mild steel and cast-iron. Use of bronze welding for repair work and the building of parts.
Flame cutting and cleaning.

TECHNICAL DRAWING

SKETCHING AND DRAWING

COMPETENCY PROFILE

1. Ability to sketch Pictorial representation of objects in relation to agricultural machinery.
2. Ability to sketch orthographic projections of components and machinery details relating to Agricultural machinery.
3. Ability to interpret and develop simple Engineering Drawings.
4. Ability to construct plain, Geometrical representations, related to perpendiculars, angles, chords, tangent, arc and circular figures.
5. Ability to interpret and design template, profiles and developments of simple shape in metal.

Course Outline

Pictorial representation of objects.
Sketching in orthographic projections of components and machine details. Interpretation of simple Engineering Drawings.
Plane Geometry related to perpendiculars, angles, chords, tangents, arc and circular figures.