

Course Code: AGE 222  
Course Title: Introduction to Farm Machinery  
Number of Units: 2 Units  
Course Duration: One Hour of Lecture and Three Hours of Practical per Week

**Course Details**

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**Course Content:**

Machine elements, shafts, gears, chain, etc.. Agricultural field implements.  
Objectives of Farm mechanization, Field implements, mechanism of operation and usage of ploughs, harrows, ridges, planters, sprayers, etc.

Practical: Students will be introduced to the implements on the field and elements shown in the workshop

**Course Requirement:**

Students must have a minimum 70% attendance and participate in all practical classes.

Reading List:

1. Culpin C.. 2001. Farm Machinery. 10<sup>th</sup> Ed. Granada Publishing. London
2. Fundamentals of Machine Operation Series. John Deere and Co. Illinois. USA
3. Hopper and Biesalslei. Small Farm Implements
4. Kepner R. A., Bainer R., Barger E.L. Principles of Farm Machinery. 2<sup>nd</sup> Ed. AVI Publishers. Connecticut. USA
5. Smith H. P., Wilkes L. H. Farm Machinery and Equipment. 6<sup>th</sup> Ed. McGraw-Hill. USA
6. Dairo, O.U 2005. Farm Machinery-Compilation of Notes.

## Farm Machinery and Power

- Equipment in the farm are classified as farm power and farm machinery
- Power provides pull/force required to operate implements... a prime mover only
  - Provide either mobile or stationary operations
- Machinery are tools/implements attached to a power source to manifest the effect of power generated. Without machinery power is useless and without power machinery are not able to perform their intended functions
- Machinery and power are complementary and the combination make up a farm equipment
- Tools..... Without frame and external power source
- Implements .... Several tools mounted on a frame and driven by an external power source

## Implement types

- Pulled....trailed
- Mounted
- Semi mounted
- Self-propelled

### **Operations of farm implements with tractor**

- Process of attaching implement to tractor is called Coupling
  - Through ... the Hitch system or PTO drive system
- Hitch system
  - Three point linkage at back of tractor ... top link and two lower links
    - Corresponding links are established on implement
  - Types of hitch system
  - One point or single hitch
  - Two-point hitch and Three-point system

- Pto drive ( Power take off)
- Tractor provides an auxiliary rotary power through a shaft to implements that require a rotary movement.
- A pair of universal joints attached to a long shaft is used ... a pto drive
- Two standard drives for farm implements..
  - 1000rpm and 540 rpm

## Power Transmission

- Power from tractors to implements are transmitted to various components called machine elements
- Transmission elements are used in determining power transmission system of any machine or equipment
- Power transmission methods
  - Belt and pulley drive
  - Shaft and universal joint drive (pto)
  - Sprocket wheel and chain drive
  - Gear drive
  - Hydraulic system

# Pulley and belt drives

- Simplest form of transmission, made up of a belt that forms a band around a set of pulley or sheave
- Belt ... a flexible material made from natural or artificial rubber, canvas or leather.
  - Flat or vee shaped belt
  - Flat belt..... rectangular, endless by metal fasteners
  - Vee-shaped belt ... trapezoidal, reduces slippage, standard sized.
  - Positive drive belt... precision or timing belt ... mesh into splines
- Pulley are cylindrical elements in form of wheels on which belt runs. Used on flat belt
  - Crowning prevents slippage
- Sheaves are made of cast iron with grooves embedded along its circumference to accept the shape of a vee - belt
  - Used for vee -belts
- Arrangements
  - Opened or closed (Cross)
- Belt speed ratio
- Belt length
- Driven power
- Belt maintenance

## Shaft and universal joint ( pto drive)

- A shaft . Hollow or solid bar on which revolving elements are mounted, subjected to all types of loading
- Axle is a solid or hollow bar carrying revolving elements but not subjected to torsion loading
- A spindle is a short rotating shaft
- Shapes are dependent on uses and design but mostly cylindrical

## Universal joints

- Used with a shaft to provide efficient power transmission at bends or corners
- Commonly used are Cardan or Hooke joint
- Pto drives are used on mounted or trailed implements such as harvester, sprayer, rotary or vibratory implements where constant angular speed are required

## Sprocket Wheel and Chain drive

- Chain drive consist of endless chain whose links are designed to engage the tooth of a heeled sprocket
- Chain
- Sprocket
- Lubrication is essential
- Avoid excessive tension
- No creep
- Distance not restricted

## Gear Drives

- Gear is a solid cylindrical element with set of tooth around its circumference
- Gear drive consist of two or more gears that engage each other with the aim of transmitting motion without shock ,minimum wear and noise.
- Gear drive is one of the most commonly used trans.. system
- Arrangement
  - Simple or Compound
- Types
  - Spur, helical, Bevel, worm
- Characteristics
  - Transmits more efficiently
  - Low power loss
  - Higher cost
  - Speed is inversely proportional to number of tooth on gear
  - Speed Ratio in Toothed Gear
    - Speed ratio for simple arrangement
    - Speed ratio for compound arrangement

## Other Elements

- Bearings
  - Radial and thrust
  - Plain or journal and Rolling contactLubrication necessary
  - effects of lubrication
    - reduces friction, acts as coolant, flushes out dirt, prevents corrosion.
- Spring
  - Designed to Provide large elastic deflection under loading

## Hydraulic system

- Method of transmitting motion through a fluid medium from a power source to a machine or component
- Allows transmission to a remote or inaccessible sections of a machine
- Makes it easier to convert rotary motion to other forms of motion
- Basic components are pump, actuator, connector, valves, sump, fluid, filters, lines, couplers.

## Hydraulic components

- Pump ... creates the flow of the fluid medium
- Converts power from the engine to fluid power
- Motor ... converts fluid power into a rotary motion where required, usually in a far place from power source.
- Actuators: devices that manifest the effect of the pump in the hydraulic system
- They are usually hydraulic cylinders and hydraulic motors
- Valves .... To control actions performed by actuators
- Three groups ... Directional ( Spool or Check)
- Pressure Valves ( Pressure control, pressure relief, by-pass, priority or pressure sequence valve, reducing valve)
- Volume control valve
  
- Lines and Couplers
- Lines are flexible tubing or hoses made of steel , copper or synthetic rubber. Have inner and outer cores resistant to oil.
- Inner core reinforced with steel/ layers of wire, or fabric braid to avoid failure
- Strength of hose inversely proportional to diameter

## Components Cont'd

- Couplers are used in joining hoses or connect hoses as part of a main system or to a secondary system.
- Hydraulic fluid
- Moving component of the system that transmit power at high pressure
- Also lubricate the system
- Viscosity is ability to resist flow
- Adequate viscosity to prevent leakages and reduced efficiency
  
- Reservoir or Sump
- Storage for the moving fluid
- Incorporates cooler to remove heat generated by fluid during movement in circuit

## **Tractor Implement Control Systems**

- Nudging
- Implements control by hand lever at side of operator by pushing forward and back to neutral position for lifting and keeping in position.
- Auto-position
- Allows selection of predetermined position of implement by positioning the hand lever control. The position is maintained for the implement during operation regardless of leakages or obstructions
  
- Auto-Draft
- Allows a selection of pre-determined draft or force required by an implement by a position on the lever control. A sensing device usually attached to the link system maintains the draft regardless of obstruction by varying the depth of penetration if used in tillage practices