COURSE CODE:	*AGE 501*
COURSE TITLE:	*Farm Machinery I*
NUMBER OF UNITS:	*3 Units*
COURSE DURATION:	*Three hours per week*

COURSE DETAILS:

Course Coordinator: **Dr. Alex Folami Adisa**
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Office Location: College of Engineering Building
Other Lecturers: None

COURSE CONTENT:

Short review of the development of mechanization in various branches of agriculture. Types of farm machinery and their field management requirements. Machine performance, costs of machine use. Farm cultural operations: clearing, tillage, planting, cultivation, fertilizer and insecticide application, harvesting. Land levelling and earth moving. Safe operation of agricultural machinery. Selection of machinery to suit the performance requirement of various agricultural operations and Nigeria conditions.

COURSE REQUIREMENTS:

This is a compulsory course for agricultural Engineering students. In view of this, students are expected to participate in all the course activities and have minimum of 75% attendance to be able to write the final examination.

READING LIST:

1. Kurmi, R. S. and Gupta, J. K. Theory of Machines. Eurasia publishing house (PVT.) Ltd. New Delhi. 2008.
2. Krutz, G., Thompson, L. and Claar, P. Design of Agricultural Machinery. John Wiley and Sons. New York. 1984.
3. Claude, C. Farm Machinery. ELBS, London, 10& 11 edition. 1981
4. Kepner, R.A., Bainer, R. and Barger, E. L. Principles of Farm Machinery. CBS Publishing & Distributors, 3 edition. New Delhi. 2005.

LECTURE NOTES

1. AGRICULTURAL MECHANIZATION

- **Definition**: It is all forms of mechanical assistance at all levels of sophistication; usually involves injection of capital and labour augmenting.
- **Mechanization policy objectives**
  Mechanization must be seen in the context of a broad agricultural development strategy whose objectives are likely to be:
  (i) agricultural productivity in order to increase the sector's contribution to economic growth and security.
  (ii) increase rural welfare; income, employment, living standards, alleviating poverty, etc.
  (iii) achieving social modernisation; attitudes and behaviour.

  Mechanization decisions need to consider:
  (i) farm power requirements to increase agricultural productivity
  (ii) appropriate technology choice consistent with resource availability and social/economic objectives.

  Mechanization as a means of increasing productivity will need to:
  Increase employment opportunities,
  Increase non- farm activity in rural sector,
  Increase food supply to farming family,
  Increase skills.

Selective mechanization

A number of Governments have advocated a selective approach to farm mechanization development in order to remove farm power constraints but avoid wasteful and undesirable effects of over mechanization. This approach begins with an assessment of power needs at farm level. The main features are:

- research and development
- mechanization planning and extension management
- provision of selected mechanization services
- formulation of mechanization packages
- institutional/ infrastructural support measures

Case study – Bacita Sugar Estate

- Mechanization on the field
- Mechanization policy achieved
- Mechanization programmes accomplished

- Selective mechanization project outputs/components
- Selective mechanization project inputs
- Agronomic and environmental variables

2 TYPES OF FARM MACHINERY AND THEIR FIELD MANAGEMENT REQUIREMENTS

Classification of Machinery used for crop production and processing

Farm machinery used for crop production and processing can be classified into land clearing, tillage equipment, sowing and planting equipment, crop protection equipment, harvesting and post harvesting equipment.

Farm Machinery Management

1. Machine capacity:

Machine system capacity is an operating characteristic determined by the rate of work achieved in operation and the amount of time over which the machine is operated. Capacity can therefore be defined as the quantity of crop (area, weight or volume) that can be handled in a given time period (season).

Machine capacity depends on:

- Rate of work – ha/hr, tonnes/hr
- Time available, hr

Factors that affects machine rate of work are:

(a) operating characteristics of machine system (or component)
(b) biological characteristics of crop being processed, yield and intensity of cropping.
(c) environmental characteristics; weather conditions- influence soil conditions and trafficability.
(d) operating decisions; knowledge of work situation, skill with machine.

Factors that affects machine time availability

(a) the physical characteristics of the machine component or system.
(b) biology characteristics of crop.
(c) environmental characteristics of production situation.
(d) operator decision.

Machine Field Performance

Farmers are constantly striving for more field- operation capacity and efficiency most especially with tillage operation

Basically three factors controls machine capacity and performance which are:

- Machine width or size
- Operation speed
- Time spent in operation

Terms related to field performance of machines

The rate at which a machine can cover a field while performing its intended function is one of the considerations in determining the cost per unit area for the operation.

- **Theoretical field capacity (TFC)**

  This is the rate of field coverage that would be obtained if the machine were performing its function 100% of the time at the rated forward speed and always covered 100% of its rated width.

- **Theoretical time per hectare**

  It is the time that would be required at the theoretical field capacity.

- **Effective field capacity**

It is the actual average rate of coverage by the machine which is expressed as hectares per hour.

- **Effective operating time-** is the time during which the machine is actually performing its intended function.
- **Field efficiency**

This is the ratio of effective field capacity to theoretical field capacity, expressed as percent.

- **Performance efficiency**

It is the measure of the functional effectiveness of a machine, e. g. the percent recovery of usable product by a harvesting machine.

EFC = SW/10 x Ef/100 where: EFC = effective field capacity, ha/hr
S = speed of travel, km/hr
W = rated width of implement, m
Ef = field efficiency, %

TFC = WxS/10 where: TFC = theoretical field capacity

Ef = EFC/TFC x 100

3. LAND CLEARING AND DEVELOPMENT OPERATION AND EQUIPMENT

The end use requirement of a developed land determines the methods or techniques of land clearing and development to be adopted.

- Factors to consider in determining methods and equipment for land clearing

Many factors affecting production and cost are included in type and density of vegetation such as number of tree size, wood density/ type(soft or hard wood), root and undergrowth. All these variables can be determined by a tree count exercise.

- Land clearing and development operations

The operations involved in land clearing and development are:

* Tree counting and site survey to determine equipment types and sizes.
* Tree felling
* Tree piling & raking, windrowing
* Root and stone raking
* Final field clearing
* Cut & fill of high and low spot respectively
* Deep plowing
* Field and block drain construction

- Land preparation for crop raising

* Trash removal
* Plowing
* Harrowing
* Land levelling and smoothening
* Row marking
* Ridging

- Agricultural land clearing package equipment

This package consist crawler tractor equipped with:

* Complete jungle land clearing protection package or forest canopy.
* Rome 'A' blade or shear blade
* Rake or brush rake
* Clearing chain
* Tree pusher
* Rome plowing, land clearing harrow.

- **Agricultural land development package equipment**

This package consist of:-
Agricultural crawler or wheel tractor equipped with:
* Light bulldozer and draft arm assembly(earth moving operation)
* Tine cultivator
* Plowing harrow
* Toolbar and 3 subsoiler tines
* Mouldboard or disc ridger if necessary
* Tiltbed trailer and winch
* Motor grader
* Land planter (land levelling operation)
* Excavator

4. TYPES OF FARM MACHINERY AND THEIR FIELD MANAGEMENT REQUIREMENTS FOR:

- Soil preparation – tillage
- Crop establishment
- Fertilizer application
- Crop protection
- Harvesting of crops like cereal and roots
- Materials handling

(a) Classification of machinery used for crop production and processing

- Tillage Machinery
    - Evaluating tillage operations
    - Types of tillage practices
    - Typical tillage field operating patterns
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5. POWER IN FARMING SECTORS

- Elements of tractors drawbar performance
    - Drawbar pull
    - Drawbar work
    - Drawbar power
    - Efficiency relationships
    - Energy and power flows through a tractor
    - Hitching implement

- **Class assignment on tractor size selection**

6. MACHINE USE COSTS

- Cost factors – Fixed and Variable Costs
- Fixed cost:
    - Depreciation cost
    - Interest charges
    - Taxes, Insurance and Shelter
- Variable cost:
    - Repairs and maintenance
    - Fuel, lubricants and miscellaneous supplies
    - Labour
- Total cost of performing a field operation
- Class assignment on machine operation cost

7. PRINCIPLE AND PRACTICE OF TESTING AND OPERATING OF AGRICULTURAL MACHINERY

- Purposes of agricultural machinery testing
    - improve the products
    - protect the customer
    - inform the customer
- Information categories
- User information
- Testing methods
    - comparative testings
    - Accelerated testings