

**NATIONAL BOARD FOR TECHNICAL EDUCATION
KADUNA**

HIGHER NATIONAL DIPLOMA

IN

PASTURE AND RANGE MANAGEMENT

CURRICULUM AND COURSE SPECIFICATIONS

2006

HIGHER NATIONAL DIPLOMA IN PASTURE AND RANGE MANAGEMENT

1.0 Programme Nomenclature

Higher National Diploma in Pasture and Range Management

2.0 Goal and Objectives

Goal: This programme is designed to produce technologists who will be able to apply scientific knowledge and skills in the development and management of pastures and rangelands for sustainable animal production consistent with conservation of the environment.

OBJECTIVES: A product of HND in Pasture and Range Management should be able to:-

- i. Plan, establish and manage sown pastures for sustainable fodder production.
- ii. Manage and improve rangelands.
- iii. Monitor pasture and rangeland utilization.
- iv. Identify different pasture and rangeland plant species.
- v. Design and implement grazing management systems.
- vi. Evaluate the carrying capacities of pasture and rangelands.
- vii. Carry out forage and fodder conservation practices
- viii. Advise livestock farmers on modern techniques on Pasture and Range management practices.

3.0 Entry requirements for HND Pasture and Range Management

The general entry requirements for the HND programme include:-

- a. All the requirements for admission into the ND programme in Agricultural technology, Animal Health and Production technology, Forestry technology and Wildlife management, i.e. Pass at credit level in any of the four subjects listed below in the senior Secondary School Certificate Examination (SSCE)
 - i. English Language
 - ii. Mathematics
 - iii. Biology/Agricultural Science
 - iv. Chemistry
 - v. Geography
 - vi. Physics
 - vii. Economics/Commerce
 - viii. Food and Nutrition

Candidates must also have a minimum of pass in English language, Mathematics and Chemistry or Pass at credit level in any of the subjects above from the National Business and Technical Examinations Board (NABTEB) or Physics at credit level and English language/Use of English, Physics, Chemistry, Biology/Agricultural Science from any of the NBTE accredited Pre-National Diploma programme.

- b. A minimum of lower credit pass (CGPA 2.50 and above) in the cognate ND examination in:-
Agricultural technology;
Animal Health and Production Technology;
Forestry technology and
Wildlife management and
- c. A minimum of one year cognate work experience;
Or, in exceptional cases, ND diplomats with a Pass (CGPA OF 2.00 – 2.49) in the ND examination that have two or more years of cognate work experience in the specific field may be considered for admission into the HND programme.

HIGHER NATIONAL DIPLOMA PASTURE AND RANGE MANAGEMENT

YEAR I SEMESTER I

| Course Code | Course Title | Theory | Practical | Total | Credit Unit |
|--------------------|----------------------------------|---------------|------------------|--------------|--------------------|
| AET 222 | Irrigation Technology | 2 | 3 | 5 | 5 |
| STB 312 | Entomology and Pest Control | 2 | 3 | 5 | 5 |
| CPT 313 | Climatology | 2 | 3 | 5 | 5 |
| PRM 311 | Range and Pasture Plant Taxonomy | 2 | 3 | 5 | 5 |
| PRM 312 | Principles of Range Management | 2 | 3 | 5 | 5 |
| COM | Computer Application I | 2 | 3 | 5 | 5 |
| GNS 301 | Use of English in Communication | 2 | - | 2 | 2 |
| | TOTAL | 12 | 15 | 32 | 32 |

HIGHER NATIONAL DIPLOMA PASTURE AND RANGE MANAGEMENT**YEAR I SEMESTER II**

| Course Code | Course Title | Theory | Practical | Total | Credit Unit |
|--------------------|--------------------------------------|---------------|------------------|--------------|--------------------|
| PRM 321 | Cereals Legume and Fodder Production | 2 | 3 | 5 | 5 |
| PRM 322 | Range Animal Nutrition | 2 | 3 | 5 | 5 |
| PRM 323 | Sown Pastures | 2 | 3 | 5 | 5 |
| PRM 324 | Range Development and Improvement | 2 | 3 | 5 | 5 |
| COM | Computer Application II | 2 | 3 | 5 | 5 |
| GNS 302 | English Language and Communication | 2 | - | 2 | 2 |
| | Entrepreneurship | 2 | 3 | 5 | 5 |
| | TOTAL | 16 | 15 | 32 | 32 |

HIGHER NATIONAL DIPLOMA PASTURE AND RANGE MANAGEMENT**YEAR II SEMESTER I**

| Course Code | Course Title | Theory | Practical | Total | Credit Unit |
|--------------------|---|---------------|------------------|--------------|--------------------|
| AES 413 | Farm Machinery and Mechanization | 2 | 3 | 5 | 5 |
| PRM 411 | Advanced Range Management | 2 | 3 | 5 | 5 |
| PRM 412 | Range Utilization Systems | 2 | 3 | 5 | 5 |
| PRM 413 | Fodder Conservation Practices | 2 | 3 | 5 | 5 |
| PRM 414 | Horse Riding and Management | 2 | 3 | 5 | 5 |
| AGR 302 | Field Experimentation and Data Analysis | 2 | 3 | 5 | 5 |
| | TOTAL | 14 | 21 | 30 | 30 |

HIGHER NATIONAL DIPLOMA PASTURE AND RANGE MANAGEMENT**YEAR II SEMESTER II**

| Course Code | Course Title | Theory | Practical | Total | Credit Unit |
|--------------------|---|---------------|------------------|--------------|--------------------|
| AEM 446 | Rural sociology | 2 | 3 | 5 | 5 |
| CPT 444 | Seed Production and Pathology | 2 | 3 | 5 | 5 |
| PRM 421 | Range Inventory and Evaluation | 2 | 3 | 5 | 5 |
| PRM 422 | Forage-Animal Stresses in Pastures and Rangelands | 2 | 3 | 5 | 5 |
| PRM 423 | Crop Residue Improvement | 2 | 3 | 5 | 5 |
| | Entrepreneurship | 2 | 3 | 5 | 5 |
| PRM 424 | Project in Pasture & Range Management | 2 | 3 | 5 | 5 |
| | TOTAL | 14 | 21 | 35 | 35 |

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| | Department/ Programme: HND | Course Code: | | Credit Hours: 3 |
| | Subject/Course: RANGE AND PASTURE PLANT TAXONOMY | PRM 311 | | Theoretical: hours/week 1 |
| | Year: I Semester: I | Pre-requisite: | | Practical: hours /week 2 |

GOAL: On completion of this course the student should be able to

General Objectives

- 1.0 Know the general principles of classification of flowering plants
- 2.0 Know how to use keys in plant classification
- 3.0 Understand classification of forage grasses
- 4.0 Understand classification of forage legumes
- 5.0 Know the classification of other fodder/browse plants
- 6.0 Know the use of herbarium

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|---------------|--|---|---|--|--|---|
| | Course Code: PRM 311 | | Credit Hours: 3 | | | |
| | Course: RANGE AND PASTURE PLANT TAXONOMY | | Theoretical: 1 hour/week | | | |
| | Year: I Semester: I | Pre-requisite: | Practical: 2 hours /week | | | |
| | Theoretical Content | | | Practical Content | | |
| | General Objective 1.0 Know the general principles of classification of flowering plants | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | List the benefits of classification of plant bioresources Explain the binomial system of nomenclature Identify the benefits of the binomial system of nomenclature | Explain: - plant bioresources binomial system of nomenclature | -marker board -charts -overhead projector -slide projector | | | |
| 2 | Explain other methods of classification e.g. season of growth, persistence, plant parts consumed, etc Classify some plant bio-resources collected from the surrounding location using binomial system of nomenclature | Explain other methods of plant classification | -marker board -charts -overhead projector -slide projector | Collect and classify local plant samples | Supervise students to collect local plant and classify, and grade the classification | Hoe Sickle Cutlass Plant press |

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| | General Objective 2: Know how to use key in plant classification | | | | | |
| 3 | Describe the components of the keys for plant classification Describe the use of keys in 2.1 above Classify sample plants collected from the surrounding location using the keys in 2.2. above | Explain keys to students | -marker board -charts -overhead projector -slide projector | Collect plant samples | Supervise students to collect and classify sample plants using keys. | Hoe Sickle Cutlass Plant press |
| | General Objective 3: Understand classification of forage grasses | | | | | |
| 4 | Identify the characteristics of the monocots Describe the morphological characteristics of forage grasses Identify forage grasses available in the surrounding location | Explain the characteristics of monocots and forage grasses | -marker board -charts -overhead projector -slide projector | Collect forage grasses and supervise student's practicals | Student to draw morphological characteristics of forage grasses. | Hoe Sickle Cutlass Plant press Pencils Drawing books Eraser |
| 5 | Classify forage grasses listed in 3.3 above using binomial system of nomenclature | Explain binomial system of nomenclature | -marker board -charts -overhead projector -slide projector | Collect forage grasses and supervise student's practicals | Students to draw classified grasses | Hoe Sickle Cutlass Plant press Pencils Drawing books Eraser |
| | General Objective 4: Understand classification of forage legumes | | | | | |
| 6 | Identify the characteristics of dicots Identify the morphological characteristics of the legume family | Explain the characteristics of dicots and their morphological features | -marker board -charts | Collect forage grasses and supervise | Students to sketch identified | Hoe Sickle Cutlass Plant press |

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| | Differentiate between the various classes of the family leguminaceae based on morphological features | | -overhead projector -slide projector | student's practicals | legume plants | Pencils Drawing books Eraser |
| 7 | List examples of forage legumes collected from the surrounding location Identify the listed forage legumes in 3.4 above by applying the binomial system of nomenclature | Explain the identified listed forage legumes above | -marker board -charts -overhead projector -slide projector | Collect and identify forage grasses and supervise student's practicals | Sketch the classes of the family leguminaceae | Hoe Sickle Cutlass Plant press Pencils Drawing books Eraser |

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| General Objective 5: Know the classification of other fodder/browse plants | | | | | | |
| 8 | Make a collection of prevalent fodder and browse plants Classify the collected specimens into monocots and dicots based on their growth and morphological features | Explain the method of collection of fodder and browse plants | -marker board -charts -overhead projector -slide projector | Collect and identify fodder and browse plants | Supervise students to collect fodder and browse plants and classify them | Hoe Sickle Cutlass Plant press Pencils Drawing books Eraser |
| 9 | Classify by applying keys, the specimens in 5.1 above into families and tribes . Identify the plants in terms of genus and species using the binomial system of nomenclature. | Classify plants using binomial system of nomenclature | -marker board -charts -overhead projector -slide projector | Collect and identify fodder grasses and browse plants | Supervise students to collect fodder and browse plants and classify them | Hoe Sickle Cutlass Plant press Pencils Drawing books Eraser |
| General Objective 6: Know the use of herbarium | | | | | | |

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| 10 | 6.1 Explain the term herbarium 6.2 Identify preserved herbarium specimens 6.3 Describe the handling of herbarium specimens 6.4 Handle herbarium specimens 6.5 Know maintenance of herbarium specimens | Explain herbarium and identify preserved herbarium specimens | -marker board -charts -overhead projector -slide projector | Guide students on how to identify preserved herbarium specimens | Students to visit herbarium. Handle herbarium specimen | Plant specimens Plant press Pencils Drawing books Eraser |
| 11 | 6.6 List materials required for preparation of herbarium specimens 6.7 List information that must go with the collected specimens 6.8 Collect sample specimens with complete information on source, location of collection, date , etc. | Explain the materials required for preparation of herbarium specimens | -marker board -charts -overhead projector -slide projector | Guide students on how to prepare herbarium specimens | Collect herbarium samples. Prepare herbarium album | Plant specimens Plant press Pencils Drawing books Eraser |
| 12 | 6.9 Prepare a herbarium album. 6.10 List treatments given to sample in preparation 6.11 Press and mount sample for storage and preservation 6.12 Describe the care of herbarium specimens in storage | Explain how to prepare a herbarium album. | -marker board -charts -overhead projector -slide projector | Guide students on how to prepare a herbarium album. | Supervise students to prepare a herbarium album | Plant specimens Plant press Pencils Drawing books Eraser |

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| | Department/ Programme: HND | Course Code: | Credit Hours: 3 |
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| | Subject/Course: PRINCIPLES OF RANGE MANAGEMENT | PRM 312 | | Theoretical: hours/week 1 |
| | Year: 1 Semester: I | Pre-requisite: | | Practical: hours /week 2 |

GOAL: The course is designed to introduce the students to the principles of range management

General Objectives

- 1.0 Know the terms used in range management
- 2.0 Know the ecological zones of Nigeria
- 3.0 Know the management of range and grazing reserves

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| | Course: PRINCIPLES OF RANGE MANAGEMENT | Course Code: PRM 312 | | Credit Hours: | | |
| | | | | Theoretical: 1 hour/week | | |
| | Year: I Semester: I | Pre-requisite: | | Practical: 2 hours /week | | |
| | Theoretical Content | | | Practical Content | | |
| | General Objective 1.0 Know the terms used in range management | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1-2 | <p>Explain range, range management, grazing reserve, legume, topography, fertility, hay, silage range condition, stocking density, overgrazing, deferred grazing</p> <p>Differentiate between rangeland and grazing reserve</p> <p>Identify rangeland animals</p> <p>Identify hay, silage</p> | <p>Explain range management and practices</p> | <p>-marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> <p>Rangeland Animals</p> <p>Plant species</p> | <p>Identify hay, silage</p> | <p>Guide students to identify hay, silage</p> | <p>Rangeland Animals</p> <p>Plant species</p> |
| | General Objective 2.0 Know the ecological zones of Nigeria | | | | | |
| 3-4 | <p>Define ecological zone</p> <p>Identify ecological zones of Nigeria i.e. Sahel Sudan, Northern Guinea, Southern Guinea, Savannah ,Forest zone</p> <p>Identify the vegetation characteristics of the zones in 2.2 above</p> | <p>Explain ecological zones of Nigeria</p> | <p>-marker board</p> <p>-map</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the vegetation characteristics of the zones</p> | <p>Guide students to identify ecological zones of Nigeria</p> | <p>Field trips to the zones</p> |

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| 5 | Draw the geographical distribution of ecological zones of Nigeria. Relate the ecological zone in 2.2 above to livestock distribution in Nigeria | Explain the geographical distribution of ecological zones of Nigeria. | -marker board -map -charts -overhead projector -slide projector | Draw the geographical distribution of ecological zones of Nigeria. | Students to sketch the ecological zones | Maps Pencils Drawing books Eraser |
| 6-7 | Differentiate between range plants and forage crops. Identify range plants Explain the role of range and forage crops in livestock production i.e. nutrition, bedding etc. | Explain the difference between range plants and forage crops | -marker board -map -charts -overhead projector -slide projector | Identify range plants and forage crops. | Guide students to identify and draw range plants, forage crops from samples | Charts Pencils Drawing books Eraser |
| General Objective 3.0 Know the management of range and grazing reserves | | | | | | |
| 8-9 | Select land for establishing grazing reserves Fence and divide rangeland into grazing paddocks | Explain how to establish grazing reserves, rangeland and grazing paddocks. | -marker board -map -charts -overhead projector -slide projector | Carryout establishment of grazing reserves, rangeland and grazing paddocks | Supervise students divide and fence rangeland | Rangeland Plant species |

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| 10-15 | <p>Fertilize range and grazing reserve Carryout weeding and slashing of the range and grazing reserve Harvest and conserve range and forage crops</p> | <p>Explain fertilizer application, weeding and slashing of the range Explain harvesting and conservation</p> | <p>-marker board -map -charts -overhead projector -slide projector</p> | <p>Carryout weeding and slashing of the range and grazing reserve</p> | <p>Supervise students to fertilize range and grazing reserve, wear and slash range and grazing reserve, harvest and conserve range plants, forage crops</p> | <p>Rangeland Plant species Fertilizers Slashers Rakes bailers</p> |
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| | Department/ Programme: HND | Course Code: PRM 321 | | Credit Hours: 3 |
| | Subject/Course: CEREALS, LEGUMES AND FODDER PRODUCTION | | | Theoretical: hours/week 2 |
| | Year: I Semester: II | Pre-requisite: | | Practical: hours /week 2 |

GOAL: The course is designed to acquaint the students with the production technologies of cereals, legumes and fodder crops for grain and fodder

General Objectives

1. Know origin and botanical features of cereals, legumes and fodder plants
2. Know preparation for planting of cereals, legumes and fodder plants
3. Know the optimum ecological – soil and climatic – requirements for production of cereals, legumes and fodder crops
4. Know land preparation for planting of cereals, legumes and fodder crops
5. Know how to sow the crop in 2.1 above after land preparation
6. Know the weed management techniques and operation
7. Know the fertilizer application rates and methods
8. Know the pest and disease control measures and methods
9. Know how to apply irrigation to crops
10. Know harvest time and technique for cereals, legumes and fodder crops
11. Know post-harvest processing, handling of cereals, legumes and fodder crops
12. Understand the uses for grain and fodder for animal feed.

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| | Course: CEREALS, LEGUMES AND FODDER PRODUCTION | Course Code: PRM 321 | | | Credit Hours: | |
| | | | | | Theoretical: 2 hours/week | |
| | Year: I Semester: II | Pre-requisite: | | | Practical: 2 hours /week | |
| | Theoretical Content | | | | Practical Content | |
| General Objective 1.0 Know origin and botanical features of cereals, legumes and fodder plants | | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | 1.1 Explain concept of origin 1.2 Identify indigenous and introduced cereals, legumes and fodder plants 1.3 Classify the plants in 1.2 above | Explain the origin of indigenous and introduced cereals, legumes and fodder plants | marker board -map -charts -overhead projector -slide projector | Identify indigenous and introduced cereals, legumes and fodder plants | Guide students to identify indigenous and introduced cereals, legumes and fodder plants | Plant samples Field visits/ trips |
| 3 | List the uses of the product of the plant in 1.2 above Human consumption Animal feed Any other industrial uses List the economic importance of the crops in 1.2 above Raw/unprocessed form Processed forms | Explain the uses of the product of the plant in 1.2 above | marker board -map -charts -overhead projector -slide projector | Identify indigenous and introduced plant species for various purposes | Guide students to identify indigenous and introduced plant species | Plant samples Field visits/ trips |

| General Objective 2: Know preparation for planting of cereals, legumes and fodder plants | | | | | | |
|---|--|--|--|---|--|---|
| 7 | List all materials required for successful planting of cereals, legume and fodder crops:- fertilizer, lime, pesticides, planting materials. Identify samples of items in 2.1 above. Procure pre-planting items and store well beforehand | Explain the materials required for successful planting of cereals, legume and fodder crops:- fertilizer, lime, pesticides, planting materials. | marker board -map -charts -overhead projector -slide projector | Identify materials required for successful planting of cereals, legume and fodder crops | Guide students to identify materials required for successful planting of cereals, legume and fodder crops | Plant samples Field visits/ trips |
| 9 | Identify local varieties of the plants available with sources. Identify sources of improved varieties plants in 1.2 above. Selects cereals, legumes and fodder plants adoptable to the locality | Explain the local varieties of the plants available with sources. | marker board -map -charts -overhead projector -slide projector | Identify local varieties of the plants available with sources. Identify sources of improved varieties plants in 1.2 above. Selects cereals, legumes and fodder plants adoptable to the locality | Guide students to identify varieties of the plants available with sources. | Plant samples Field visits/ trips Seeds Fertilizers Pesticides |
| General Objective 3.0 Know the optimum ecological (soil and climatic) requirements for production of cereals, legumes and fodder crops | | | | | | |
| 13 | Identify soil requirements for planting of cereals, legumes and fodder crops. Soil type; Soil pH Fertility level Drainage status | Explain the soil requirements for planting of cereals, legumes and fodder crops. Explain climatic requirements of the growth of the crops | marker board -map -charts -overhead projector -slide projector | Identify soil requirements for planting of cereals, legumes and fodder crops. Identify climatic requirements of | Guide students to identify soil and climatic requirements for planting of cereals, legumes and fodder crops. | Farmland Plant samples Field visits/ trips Seeds Fertilizers Pesticides |

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| | Identify climatic requirements of the growth of the crops as listed above Rainfall ii. Temperature iii. Photoperiod | | | the growth of the crops | | |
| General Objective 4.0 Know land preparation for planting of cereals, legumes and fodder crops | | | | | | |
| 15 & 16 | 4.1 Describe the following plant preparation operation Land clearing Ploughing Harrowing Ridging 4.2 Carry out the operation in 4.1 above | Explain plant preparation operations Explain operations procedures | marker board -charts -overhead projector -slide projector | Carry out plant preparation operations | Supervise students to clear land plough, harrow and weed | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |
| General Objective 5.0 Know how to sow the crop after land preparation | | | | | | |
| 17 | Carry out germination test on seeds Observe the seed planting for pathological Problem Soak seed overnight | Explain germination tests and procedures | marker board -charts -overhead projector -slide projector | Carry out germination test on seeds Observe the seed planting for pathological problem Soak seed overnight | Test seeds for germination | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |
| 18 | Carryout seed treatment by use of fungicide, insecticides Sow seeds by applying proper spacing by: manual sowing machine sowing | Explain seed treatment methods | marker board -charts -overhead projector | Carryout seed treatment by use of fungicide, insecticides | Take students to field to sow seeds | Farmland Plant samples Field visits/trips Seeds |

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| | | | -slide projector | Sow seeds by applying proper spacing by: manual sowing machine sowing | | Fertilizers Pesticides |
| General Objective 6.0 Know the weed management techniques and operations | | | | | | |
| 19 | <p>6.1 Carry out weed identification</p> <p>Carry out weed control applying the following methods:</p> <ul style="list-style-type: none"> - Weed control methods <ul style="list-style-type: none"> Manual by hoeing Chemical weed control <ul style="list-style-type: none"> i. Pre-emergence herbicides ii. Post emergence herbicides iii. Selective and general contact herbicides <p>Identify materials for chemical herbicide application (chemicals, knapsack sprayers and their maintenance)</p> | Explain weed identification and control using various methods | marker board -charts -overhead projector -slide projector | Carryout weed identification and control using various methods | Supervise students identify weed and control weed. Grade reports identify herbicide application | Farmland Plant samples Field visits/ trips Seeds Fertilizers Pesticides |
| 20 | <p>Identify <i>Striger hermionthica</i> weed</p> <p>Control <i>Striger hermionthica</i> by</p> <ul style="list-style-type: none"> Chemical control Time of planting Farm hygiene | Explain <i>Striger hermionthica</i> and the various methods of its control | marker board -charts -overhead projector -slide projector | Identify <i>Striger hermionthica</i> weed Control <i>Striger hermionthica</i> by Chemical control Time of planting Farm hygiene | Take students to field to carryout these operations | Farmland Plant samples Field visits/ trips Seeds Fertilizers Pesticides |
| General Objective 7.0 Know fertilizer application rates and methods | | | | | | |
| 21 | <p>Identify types of fertilizer: single, compound and complete fertilizers</p> <p>Explain the uses of fertilizer</p> <p>Determine the fertilizer rate for the crops</p> <p>Calculate total quantity of fertilizer for application</p> | <p>Explain types of fertilizer: single, compound and complete fertilizers</p> <p>Explain the uses of fertilizer</p> | marker board -charts -overhead projector -slide projector | Identify types of fertilizer: single, compound and complete fertilizers Explain the uses of fertilizer | Take students to field to carryout these operations | Farmland Plant samples Field visits/ trips Seeds Fertilizers |

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| | | Determine the fertilizer rate for the crops Calculate total quantity of fertilizer for application | | Determine the fertilizer rate for the crops Calculate total quantity of fertilizer for application | | Pesticides |
| General Objective 8.0 Know pest and disease control measures and methods | | | | | | |
| 24 | <p>8.1 Identify the pest problems of cereals, legumes and fodder crops</p> <ul style="list-style-type: none"> insects birds nematodes/eelworm rodents <p>8.2 Describe the control strategies of pests in 8.1 above</p> <p>i. Insect – choice of insecticides for application</p> <ul style="list-style-type: none"> - when to apply the chemical - mixing the insecticide with water according to manufacturer’s specification. - application technique by use of knapsack sprayer <ul style="list-style-type: none"> - care and precaution by the personnel, dressing mask, gloves, etc - care of the equipment after use - use knapsack sprayer to apply an insecticide on a sample plot. <p>ii. <u>Birds</u>: -List type of birds that constitute problems</p> <ul style="list-style-type: none"> - Scaring of birds by human labour - Scaring of birds by use of scarecrow | Explain pest problems of cereals, legumes and fodder crops and their control strategies | marker board -charts -overhead projector -slide projector | Identify the pest problems of cereals, legumes and fodder crops Insects, birds nematodes/ eelworm, rodents | Guide students to identify the pest problems of cereals, legumes and fodder crops | Farmland Plant samples Field visits/ trips Seeds Fertilizers Pesticides |

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| | <ul style="list-style-type: none"> - Construct and place scarecrow on the field plot <p>iii. <u>Nemotodes</u>: - List types of nematodes that attack crops Describe the control of nematodes:</p> <ul style="list-style-type: none"> - by use of chemical (Nemagon) - by use of farm hygiene - by use of nematode – resistant varieties <p>iv. <u>Rodents</u>: -List the type of rodents constituting pests</p> <ul style="list-style-type: none"> - Control by– use of traps - use of chemical (rodenticides) | | | | | |
| 25 | <p>8.3 List the disease problems of the crops in 8.1 above</p> <p>i.Fungal diseases control measures</p> <ul style="list-style-type: none"> - use chemical fungicides - calculate dilution of a given chemical as directed by manufacturers <p>ii.Bacterial disease- control by pulling and destroying the affected plant</p> <p>iii.Viral diseases – list viral diseases</p> <ul style="list-style-type: none"> - control by spraying insecticides at the appropriate time to destroy vectors (transmitting insects) -Farm hygiene: Pull, destroy and bury affected plants. | Explain the disease problems of the crops | marker board -charts -overhead projector -slide projector | Identify disease problems of the crops | Guide students to disease problems of the crops | Farmland Plant samples Field visits/ trips Seeds Fertilizers Pesticides |

| General Objective 9.0 Know how to apply irrigation to crops | | | | | | |
|---|--|---|--|---|--|---|
| 26 | 9.1 Identify sources of water for irrigation Perennial streams Fadama - Borehole Tap water 9.2 Describe types of irrigation Furrow Sprinkler Drip | Explain sources of water for irrigation Describe types of irrigation | marker board -charts -overhead projector -slide projector | Identify sources of water for irrigation Irrigate plots and fields using different types of irrigation | Guide students to irrigate plots and fields using different types of irrigation | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |
| 27 | Identify appropriate and feasible irrigation system for the crops Apply sprinkler/furrow irrigation to crops | Explain appropriate and feasible irrigation system for the crops | marker board -charts -overhead projector -slide projector | Identify appropriate and feasible irrigation system for the crops Apply sprinkler/furrow irrigation to crops | Guide students to identify appropriate and feasible irrigation system for the crops and apply sprinkler/furrow irrigation to crops | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |
| General Objective 10: Know the harvest time and technique for cereals, legumes and forage plants | | | | | | |
| 28 | List the external signs of harvest maturity for grains tassels leaf browning dry condition shattering 10.2 Describe various harvesting technique Harvesting for grain | Explain external signs of harvest maturity for Grains Explain various harvesting technique | marker board -charts -overhead projector -slide projector | Identify external signs of harvest maturity for grains | Take students to the field to identify mature crops. | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |

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| | Harvesting for hay Harvesting for silage Manual harvesting Harvesting by combine harvester Harvest cereals, legumes and forage plants. | | | Identify various harvesting technique | Supervise students to harvest | |
| General Objective 11: Know post-harvest processing handling of cereals, legumes and forage plants | | | | | | |
| 30 | Describe various post-harvest operations for cereals, legumes and forage crops. 1. Drying sun drying in swaths or windrows use of dryers 2. Shelling manual use of machine | Explain various post-harvest operations for cereals, legumes and forage crops. | marker board -charts -overhead projector -slide projector | Identify various post-harvest operations for cereals, legumes and forage crops. | Supervise students | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |
| 31 | 3. Threshing and winnowing/clearing i. manual ii. use of machine iii. Dry, thresh and clean sample seeds. Carry out the post harvest operations in 11.1 above. Quality assessment of grain i. plumpness/filling status ii. contamination status e.g. contamination with debris and foreign seeds | Explain out the post harvest operations | marker board -charts -overhead projector -slide projector | Carry out the post harvest operations | Supervise students dry, shall, thresh and winnow. Assess quality of grains and report | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |
| 32 | Estimate yield of crops i. for grain in kg/ha at 15% moisture content ii. for fodder in terms of herbage dry matter yield in tons per hectare Identify :types of basis for grain bag for grain, type of bag to use | Explain yield of crops i. for grain in kg/ha at 15% moisture content ii. for fodder in terms of herbage dry matter yield in tons per hectare | marker board -charts -overhead projector -slide projector | Estimate yield of crops i. for grain in kg/ha at 15% moisture content ii. for fodder in terms of herbage dry matter yield in tons per hectare Identify types of basis for grain, | Supervise students carry out yield estimation | Farmland Plant samples Field visits/trips Seeds Fertilizers Pesticides |

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| | | | | bag for grain, type of bag to use | | |
| 33. | <p>Explain:</p> <ul style="list-style-type: none"> Type of storage condition Proper aeration in storage Techniques to avoid/minimize heat build-up Use of agro-botanicals and other protectants List possible protectants in storage Bag sample grain with and without protectant | <p>Explain storage facilities and protection methods and protectants.</p> | <ul style="list-style-type: none"> marker board -charts -overhead projector -slide projector | <p>Identify storage facilities and protection methods and protectants</p> | <p>Supervise students to construct storage facilities</p> | <p>Farmland Plant samples Field visits/ trips Seeds Fertilizers Pesticides</p> |
| General Objective 12: Understand the uses of grain and fodder for animal feed | | | | | | |
| 34 | <p>12.1 Identify the cereal and legume crop grains used in feed formulation mixtures</p> <ul style="list-style-type: none"> - Major contributions of cereal grains - Major contributions of legume grains <p>12.2 Explain the use of Fodder for animal feed</p> <ul style="list-style-type: none"> - for stall feeding - as silage - as hay - for stockpiling for animal feed during scarcity <ul style="list-style-type: none"> - Grazing of harvest remains by stock and benefits in nutrient cycling. | <p>Explain the types of cereal and legume crop grains used in feed formulation mixtures</p> <p>Explain the use of Fodder for animal feed</p> | <ul style="list-style-type: none"> marker board -charts -overhead projector -slide projector | <p>Identify the cereal and legume crop grains used in feed formulation mixtures</p> <ul style="list-style-type: none"> - Major contributions of cereal grains - Major contributions of legume grains | <p>Supervise students to identify the cereal and legume crop grains used in feed formulation mixtures</p> | <p>Farmland Plant samples Field visits/ trips Grains</p> |

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| | Department/ Programme: | Course Code: | | Credit Hours: |
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| | Subject/Course: RANGE ANIMAL NUTRITION | PRM 322 | | Theoretical: hours/week 2 |
| | Year: I Semester: II | Pre-requisite: | | Practical: hours /week: 3 |

GOAL: Know the nutrition of the free-range grazing animal for making adequate provision for sustained productivity

General Objectives

- 1.0 Understand the principles of nutrition of the free-range grazing herbivore
- 2.0 Know the various classes of feedstuff on rangelands
- 3.0 Know the nutrient requirement for the various activities of the herbivore
- 4.0 Know how to match/balance plant nutrient and animal nutrient requirement

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| | Course: RANGE ANIMAL NUTRITION | Course Code: PRM 322 | | Credit Hours: 2 | | |
| | | | | Theoretical: 3 hours/week | | |
| | Year: | Semester: | Pre-requisite: | | Practical: hours /week | |
| | Theoretical Content | | | Practical Content | | |
| | General Objective 1: Understand the principles of nutrition of the free-range grazing herbivore | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | <p>1.1 Describe anatomical characteristics of the herbivore that adapts it to free range grazing.</p> <p>1.2 Explain the nutritional requirements of various classes of herbivores and omnivores.</p> <p>1.3 Explain the digestive system: ingestion, digestion, absorption and metabolism of herbivores and omnivores.</p> <p>1.4 Explain the adaptation of the alimentary system to free range grazing.</p> | <p>1.1 Describe anatomical characteristics of the herbivore that adapts it to free range grazing.</p> <p>1.2 Explain the nutritional requirements of various classes of</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Calculate the nutritional requirements of various classes of herbivores and omnivores.</p> <p>Identify and draw alimentary</p> | <p>Guide students to calculate the nutritional requirements of various classes of</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> |

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| | | <p>herbivores and omnivores.</p> <p>1.3 Explain the alimentary system, ingestion, digestion, absorption and metabolism in herbivores and omnivores.</p> <p>1.4 Explain the adaptation of the alimentary system to free range grazing.</p> | | <p>system of herbivores and omnivores.</p> | <p>herbivores and omnivores</p> <p>.</p> <p>Guide students to identify and draw alimentary system of herbivores and omnivores</p> <p>.</p> | |
| General Objective 2: Know the various classes of feedstuff on rangelands | | | | | | |
| 3 | <p>2.1 Identify the various feedstuffs on rangeland.</p> <p>2.2 Classify the various feedstuffs on rangeland.</p> | <p>Describe the various feedstuffs on rangeland.</p> <p>Describe system of forage feed analysis.</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the various feedstuffs on rangeland.</p> <p>Identify the nutritional values of different</p> | <p>Guide students to identify various feedstuffs on rangeland.</p> <p>Guide students to</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> <p>Farmland Plant samples</p> |

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| | <p>2.3 Identify the nutritional values of different feedstuffs on rangeland.</p> <p>2.4 Describe system of forage feed analysis.</p> <p>2.5 Explain proximate components of range Forages.</p> <p>2.6 Explain the determinants of forage nutritive value including palatability, voluntary intake and digestibility.</p> <p>2.7 Identify the determinants in rangeland.</p> | <p>Explain proximate components of range Forages.</p> <p>Explain the determinants of forage nutritive value including palatability, voluntary intake and digestibility.</p> | | feedstuffs on rangeland. | identify the nutritional values of different feedstuffs on rangeland. | Field visits/ trips |
| General Objective 3.0: Know the nutrient requirement for the different physiological states of the herbivore | | | | | | |
| 9 | <p>3.1 Identify the various physiological states of the herbivore, eg puberty, growth, reproduction, lactation, etc.</p> <p>3.2 Identify the nutritional requirements of herbivore in 3.1.</p> <p>3.3 Describe animal feed requirements in terms of quantity and quality for meeting the various physiological states.</p> | <p>Describe the various physiological states of the herbivore, eg puberty, maintenance, growth, reproduction, lactation, etc.</p> <p>Describe the nutritional requirements of herbivore</p> <p>Describe animal feed requirements in</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the various physiological states of the herbivore, eg puberty, maintenance, growth, reproduction, lactation, etc.</p> <p>Identify the nutritional requirements of herbivore</p> | <p>Guide students to:</p> <p>Identify the various physiological states of the herbivore, eg puberty, maintenance, growth, reproduction, lactation, etc.</p> <p>Identify the nutritional requirements of herbivore</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> <p>Farmland Plant samples</p> <p>Field visits/ trips</p> |

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| | | terms of quantity and quality for meeting the various states. | | Identify animal feed requirements in terms of quantity and quality for meeting the various states. | on, lactation, etc. Identify the nutritional requirements of herbivore Identify animal feed requirements in terms of quantity and quality for meeting the various states. | |
| General Objective 4.0: Know how to match/balance plant nutrient and animal nutrient requirement | | | | | | |
| 13 | 4.1 Assess the nutritional requirement of forage animal nutrient composition and animal nutrient Requirement. | Explain 4.1- 4.4. | marker board -charts | Analyse the nutrient content of forages and | Teach students in assessing nutrient | marker board -charts |

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| | <p>4.2 Assess the nutritional content of feed from the animal in 4.1.</p> <p>4.3 Assess the nutrient/feed balances indicating deficiency, adequacy and excess (toxicity).</p> <p>4.4 Explain the concept of supplementation.</p> | | <p>-overhead projector</p> <p>-slide projector</p> | <p>conduct feeding trials with animals</p> | <p>compositions and requirements</p> | <p>-overhead projector</p> <p>-slide projector</p> <p>Farmland</p> <p>Plant samples</p> <p>Field visits/trips</p> |
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| | <i>Department/ Programme:</i> | Course Code: | | Credit Hours: |
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| | Subject/Course: SOWN PASTURES PRODUCTION | PRM 323 | | Theoretical: hours/week |
| | Year: Semester: | Pre-requisite: | | Practical: hours /week |

GOAL: Know how to establish and manage sown pastures for sustainable production

General Objectives

Know the different types of pastures

Know the importance of establishing pastures

3.0 Know the edaphic, climatic and biotic requirements in establishing sown pastures.

4.0 Know the cultural practices used in establishing and maintenance of sown pastures.

5.0 Know the post-establishment management practices involved in sustaining sown pastures.

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|---------------|--|---|--|---|---|---|
| | Course: SOWN PASTURES PRODUCTION | Course Code: PRM 323 | | Credit Hours: | | |
| | | | | Theoretical: hours/week | | |
| | Year: I Semester: II | Pre-requisite: | | Practical: hours /week | | |
| | Theoretical Content | | | Practical Content | | |
| | General Objective 1.0 Know the types and significance of establishing pasture in animal production system | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | Define sown pastures. Differentiate the different types of sown pastures Identify different types of sown pastures State the criteria for selection of sown pastures species. | Explain different types of sown pastures State the criteria for selection of sown pastures species | marker board -charts -overhead projector -slide projector | Identify different types of sown pastures | Guide students to identify different types of sown pastures | Farmland Plant samples Field visits/ trips |
| | General Objectives 2.0 Know the importance of establishing pastures | | | | | |
| 2 | Explain the importance of pastures Explain the use of sown pastures Determine the economics of sown pastures | Explain the importance of pastures Explain the use of sown pastures | marker board -charts -overhead projector -slide projector | Determine the economics of sown pastures | Guide students to determine the economics of sown pastures | Farmland Plant samples Field visits/ trips |
| | General Objective 3.0 Know the edaphic, climatic and biotic requirements in establishing sown pastures | | | | | |

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| 3 | <p>3.1 Define the following terminologies edaphic, climatic, and biotic factors.</p> <p>3.2 Explain the effect of 2.1 above on sown pastures.</p> <p>List the favourable edaphic; climatic and biotic for sown pastures production.</p> | Explain the effect of edaphic, climatic, and biotic factors. | marker board -charts -overhead projector -slide projector | Carryout field surveys to identify edaphic, climatic, and biotic requirements in establishing sown pastures | Guide students to identify edaphic, climatic, and biotic requirements in establishing sown pastures | Farmland Plant samples Field visits/ trips |
| General Objective 4.0 Know the cultural practices in establishing and maintenance of sown pastures | | | | | | |
| 4 | <p>4.1 Describe the pre-planting treatments required to enhance germination like scarification, rhizobium inoculation, fungicide and pesticide application.</p> <p>4.2 Describe all the field operations involved in establishing pastures such as site selection, plant preparation; sowing/planting methods, fertilization application etc.</p> <p>4.3 Describe all the various stages of phenological physiological stages of pasture plant growth like germination, seedling vegetative, bloom and maturity</p> <p>4.4 Establish a pasture field.</p> | Explain 4.1- 4.4 . | marker board -charts -overhead projector -slide projector | Use different methods to scarify seeds Establish and monitor development of different pasture spp. | Guide students to: Scarify seeds Establish and monitor development of different pasture spp. | Farmland Plant samples Field visits/ trips H ₂ SO ₄ Hot Water |
| General Objective 5.0 Know the post-establishment management practices involved in sustaining sown pastures. | | | | | | |
| 5 | <p>5.1 Describe post establishment processes used in pastures e.g. weed control; soil fertility management, pest control, grazing management systems etc.</p> <p>5.2 Maintain and establish pastures.</p> | Explain post establishment processes used in pastures e.g. weed control; soil fertility management, pest control, grazing management systems etc. | marker board -charts -overhead projector -slide projector | Carryout maintenance of established pastures | Guide students to carryout maintenance of established pastures | Farmland Plant samples Field visits/ trips |

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| | Department/ Programme: | Course Code: | | Credit Hours: 2 |
| | Subject/Course: RANGE DEVELOPMENT AND IMPROVEMENT | PRM 324 | | Theoretical: hours/week 2 |
| | Year: I Semester: II | Pre-requisite: | | Practical: hours /week 3 |

GOAL: Know the process of identifying, delineating and mapping fields based on land capability

General Objectives

Know parameters used in assessing needs for range improvement.

Know the alternative options available for improving rangelands

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| | Course: RANGE DEVELOPMENT AND IMPROVEMENT | Course Code: PRM 324 | | Credit Hours: |
| | | | | Theoretical: 2 hours/week |
| | Year: I Semester: II | Pre-requisite: | | Practical: 3 hours /week |
| | Theoretical Content | | | Practical Content |
| | General Objective 1.0 Know parameters used in assessing range quality | | | |

| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
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| 1 | <p>1.1 Explain delineation; demarcation and mapping; and land capability classes; appraisal; condition classes; range trend; regression and retrogression.</p> <p>1.2 Explain the significance of the factors in 1.1 above in determining range quality.</p> <p>1.3 Determine range quality applying the parameters in 1.1 above.</p> | <p>Explain delineation; demarcation and mapping; and land capability classes; appraisal; condition classes; range trend; regression and retrogression.</p> <p>Explain the significance of the factors in 1.1 above in determining range quality.</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Delineate and map land capability and classes.</p> <p>Appraise existing condition and trend or range</p> | <p>Guide students to:</p> <p>Delineate and map land capability and classes.</p> <p>Appraise existing condition and trend or range</p> | <p>Farmland</p> <p>Plant samples</p> <p>Field visits/ trips</p> |
| General Objective 2.0 Know the alternative options available for improving rangelands | | | | | | |
| 2 | <p>Describe the different techniques/used in improving range productivity:- controlled grazing; control of undesirable plants sp; predators; control land pests; prescribed burning; reseeded ; fertilization</p> <p>Apply the techniques in 2.1 above to improve rangeland.</p> | <p>Explain the different techniques/used in improving range productivity:- controlled grazing; control of undesirable plants sp; predators; control land pests; prescribed burning; reseeded, fertilization</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Carryout excursion to grazing areas.</p> | <p>Guide students during excursion</p> | <p>Farmland</p> <p>Plant samples</p> <p>Field visits/ trips</p> |

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| Department/ Programme: HND | Course Code: | | Credit Hours: 3 |
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| | Subject/Course: ADVANCED RANGE MANAGEMENT | PRM 411 | | Theoretical: hours/week 1 |
| | Year: II Semester: I | Pre-requisite: | | Practical: hours /week 4 |

GOAL:- The course is designed to prepare students for proper management of rangelands for sustained animal production

General Objectives

- 1.0 Know the regulations for establishing and gazetting of grazing reserves
- 2.0 Know the different types of grazing systems
- 3.0 Know the major infrastructural facilities required for proper rangeland utilization
- 4.0 Know the classes of livestock that use rangelands
- 5.0 Know the different methods of forage conservation
- 6.0 Know the problems of poisonous plants on rangelands

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|---------------|---|--|--|--|--|---|
| | Course: ADVANCED RANGE MANAGEMENT | Course Code: PRM 411 | | Credit Hours: | | |
| | | | | Theoretical: hours/week | | |
| | Year: II Semester: I | Pre-requisite: | | Practical: hours /week | | |
| | Theoretical Content | | | Practical Content | | |
| | General Objective 1.0 Know the regulations for establishing and gazettement of grazing reserves | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | <p>Explain the current government laws on land use in Nigeria and West Africa.</p> <p>Explain the traditional land ownership and tenure system.</p> <p>Describe the process of acquiring land for a grazing reserve.</p> | <p>Explain the current government laws on land use in Nigeria and West Africa</p> <p>Explain the traditional land ownership and tenure system</p> <p>Describe the process of acquiring land for a grazing reserve.</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> <p>Gazetted laws</p> | <p>Describe the process of acquiring land for a grazing reserve.</p> | <p>Show students the laws and interpret them</p> | <p>Gazetted laws</p> |
| | General Objective 2.0 Know the different types of grazing systems | | | | | |
| 2- 3 | <p>List different types of grazing systems</p> <p>Explain continuous grazing system, rotational grazing system, deferred grazing system, strip grazing system, zero grazing system</p> <p>Describe the application of the systems in 2.2 above.</p> | <p>List the different types of grazing systems</p> <p>Explain continuous grazing system, rotational grazing system, deferred grazing system, strip grazing</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the different types of grazing systems</p> | <p>Show students the laws and interpret them</p> | <p>Grazing lands</p> <p>Gazetted laws</p> |

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| | | system, zero grazing system Describe the application of the systems in 2.2 above. | Gazetted laws | | | |
| General Objective 3.0 Know the major infrastructural facilities required for proper rangeland utilization | | | | | | |
| 4- 7 | List the natural and acquired features of a rangeland e.g. Sketch a typical rangeland Describe the major structural facilities needed for proper rangeland utilization e.g. fencing water development, salting facilities dip/spray race facilities for ecto parasite control. Establish the following facilities on a rangeland:- a. tick powder point b. salting facilities c. water points d. fencing Explain the limitations of improperly planned rangeland | Explain the natural and acquired features of a rangeland | marker board -charts -overhead projector -slide projector Gazetted laws | Sketch a typical rangeland Establish the following facilities on a rangeland:- tick powder point, salting facilities, water points, fencing | Show students the laddws and dinterpret them | Grazing lands Gazetted laws |
| General Objective 4.0 Know the classes of livestock that use rangeland | | | | | | |
| 8- 9 | Identify rangeland animals i.e. cattle, sheep, goats and wildlife Determine the peculiar nutritional needs of each class of rangeland animal Determine the stocking rates and carrying capacities of the rangelands Explain animal units | Determine the peculiar nutritional needs of each class of rangeland animal Determine the stocking rates and carrying capacities of the rangelands Explain animal units | marker board -charts -overhead projector -slide projector Gazetted laws | Guide students to identify rangeland animals i.e. cattle, sheep, goats and wildlife | Identify rangeland animals i.e. cattle, sheep, goats and wildlife | Grazing lands Gazetted laws Cattle, Sheep, Goats, Wildlife |
| General Objective 5.0 Know the different methods of forage conservation | | | | | | |
| 10- 13 | List the characteristics of good quality hay and silage Identify good quality hay | | marker board | Identify good quality hay | Supervise students | Grazing lands |

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| 14 | Describe the methods of making hay Describe the methods for making silage Explain standing hay Describe how to prepare hay Describe how to prepare silage | List the characteristics of good quality hay and silage Describe the methods of making hay Describe the methods for making silage Explain standing hay | -charts -overhead projector -slide projector Gazetted laws | Prepare hay Prepare silage | prepare hay, silage. Asses the prepared hay, silage. | Gazetted laws Cattle, Sheep, Goats Wildlife |
| 15 & 16 16 | General Objective 6.0 Know the problems of poisonous plants on rangelands | | | | | |
| | Explain the problems of plant poisoning on the range Identify poisonous plants occurring on rangelands Identify poisonous plants in the immediate environment. Explain the techniques of poisonous plant control and management Control poisonous plants in the rangeland | Show students poisonous range plants | marker board -charts -overhead projector -slide projector | Identify and collect specimens of poisonous plants occurring on rangelands | Prepare weed album of poisonous range plants | Collected weeds |

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| | Department/ Programme: HND | Course Code: | | Credit Hours: 2 |
| | Subject/Course: RANGE UTILIZATION SYSTEMS | PRM 412 | | Theoretical: hours/week 2 |
| | Year: II Semester: I | Pre-requisite: | | Practical: hours /week 3 |

GOAL: The course is designed to provide the students with the knowledge of production and utilization of range forage

General Objectives

- 1.0 Know the history and distribution of major rangelands in Nigeria
- 2.0 Know the principles of range utilization in livestock nutrition
- 3.0 Know the types and classes of rangeland
- 4.0 Know the management of rangelands
- 5.0 Know the various ways of preserving and storing of range forages
- 6.0 Know the role of government in rangeland development

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|---------------|---|-----------------------------|--|---|--|--------------------------------------|---|
| | | Course Code: PRM 412 | | | | Credit Hours: | |
| | Course: RANGE UTILIZATION SYSTEMS | | | | Theoretical: 2 hours/week | | |
| | Year: | Semester: | Pre-requisite: | | | Practical: 3 hours/week | |
| | Theoretical Content | | | | Practical Content | | |
| | General Objective 1.0 Know the history and distribution of major rangelands in Nigeria | | | | | | |
| Week/s | Specific Learning Objectives | | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | <p>Outline the history of range land development in Nigeria.</p> <p>Explain using a map the geographical distribution of major range plants in Nigeria</p> <p>Explain factors limiting range land productivity in Nigeria e.g.</p> <p>i. climate ii. Soil fertility</p> | | <p>Explain using a map the geographical distribution of major range plants in Nigeria</p> <p>Explain factors limiting range land productivity in Nigeria e.g.</p> <p>i. climate ii. Soil fertility</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Draw the history of range land development in Nigeria.</p> | <p>Show samples of forage plants</p> | <p>Maps</p> <p>Preserved or fresh forage plants</p> |
| | General Objective 2.0 Know the principles of range utilization in livestock nutrition | | | | | | |
| 2 | <p>Explain the importance of the range forage in livestock nutrition.</p> <p>List the factors affecting the feeding value of range forages e.g.</p> | | <p>Explain the importance of the range forage in livestock nutrition.</p> | <p>marker board</p> <p>-charts</p> | <p>Explain the importance of the range forage in livestock nutrition</p> | <p>Visit local rangeland</p> | <p>Vegetation map of Nigeria</p> |

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| | <p>quality amount, botanical composition botanical compete Explain the importance of range forage in the nutrition of animals: beef cattle, dairy cattle, sheep and goats swine, rabbits and poultry.</p> | <p>List the factors affecting the feeding value of range forages e.g. quality amount botanical compete Explain the importance of range forage in the nutrition of animals: beef cattle, dairy cattle, sheep and goats swine rabbits and poultry.</p> | <p>-overhead projector -slide projector Vegetative map of Nigeria</p> | | | <p>Local rangeland</p> |
| General Objective 3.0 Know the types and classes of range lands | | | | | | |
| 3 | <p>Explain the basis on which rangelands can be classified e.g. Duration of use, age and types of forage plants. Identify the various range plants common to the immediate locality</p> | <p>Explain the basis on which rangelands can be classified e.g. Duration of use, age and types of forage plants.</p> | <p>marker board -charts -overhead projector -slide projector Vegetative map of Nigeria</p> | <p>Identify the various range plants common to the immediate locality</p> | <p>Visit nearby rangelands, students to prepare weed album</p> | <p>Plant spp Drawing materials Weed album</p> |
| General Objective 4.0 Know the management of rangelands | | | | | | |
| 4 | <p>List the principles governing the management of range lands. controlled grazing fencing water provision etc Explain the principles in 4.1 above</p> | <p>Explain the principles governing the management of range lands, controlled grazing Fencing, water provision etc</p> | <p>marker board -charts -overhead projector -slide projector</p> | <p>Conduct field trips to various rangelands and demonstrate management practices</p> | <p>Guide students during field trips to various rangelands and demonstrate</p> | <p>Rangeland Water Fences</p> |

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| | Describe methods of range land improvement i.e. deferring grazing, fertilization, reseeding introduction of new species, burning. | | Vegetative map of Nigeria | | management practices | |
| 5 | Explain the role of climate and soil on rangeland productivity. Establish grass and legume fodder banks Make an album of the major range plants | Explain method of establishing fodder banks. Describe method of making plant herbarium | marker board -charts -overhead projector -slide projector Vegetative map of Nigeria | Establish grass and legume fodder banks Make an album of the major range plants | Supervise students establish fodder banks. Supervise students make used album | Pasture seeds Plant press |
| General Objective 5.0 Know the various ways of preserving and storing of range forages | | | | | | |
| 6 | List the advantages of range forage preservation and storage. Differentiate between hay silage and bush. Explain the characteristics of quality hay. Describe methods of preparing and curing hay. | Explain the characteristic of quality hay Explain methods of preparing and curing hay. | marker board -charts -overhead projector -slide projector Vegetative map of Nigeria | Carryout preparation and curing hay and silage. | Show students hay, silage, forage. Students to identify quality hay | Grasses Silos |
| General Objective 6: Know the role of government in rangeland development | | | | | | |
| 7 | Explain the role of government in the management of rangelands. Explain the contribution of research institutes in the development of rangelands. | Explain the role of government in the management of rangelands. Explain the contribution of research institutes in the development of rangelands. | marker board -charts -overhead projector -slide projector | Identify any laws on rangeland use | Guide students to identify any laws on rangeland use | Laws Gazettes |

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| | | | Vegetative map of Nigeria | | | |
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|--|---|---------------------|--|----------------------------------|
| | <i>Department/ Programme:</i> | Course Code: | | Credit Hours: 3 |
| | Subject/Course: FODDER CONSERVATION PRACTICES | PRM 413 | | Theoretical: hours/week 2 |

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|--|--------------|------------------|-----------------------|--|---------------------------------|
| | Year: | Semester: | Pre-requisite: | | Practical: hours /week 3 |
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Goal: To know how to make hay and silage.

General Objectives

- 1.0 Know the two forms and importance of conserved fodder
- 2.0 Know the processes involved in hay making
- 3.0 Know the processes involved in silage making
- 4.0 Acquire skills in strategies use of conserved fodder.
- 5.0 Know the economics of hay and silage making

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|---------------|--|---|---|---|---|---|
| | Course: FODDER CONSERVATION PRACTICES | Course Code: PRM 413 | | Credit Hours: | | |
| | | | | Theoretical: 2 hours/week | | |
| | Year: II Semester: I | Pre-requisite: | | Practical: 3 hours /week | | |
| | Theoretical Content | | Practical Content | | | |
| | General Objective 1: Know the two forms and importance of conserved fodder | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | <p>Explain fodder</p> <p>Identify the different forms of conserving fodder e.g. hay, silage etc</p> <p>1.3 Explain the reasons and importance of conserving fodder</p> | <p>Explain the reasons and importance of conserving fodder</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the different forms of conserving fodder e.g. hay, silage etc</p> | <p>Guide students to identify the different forms of conserving fodder e.g. hay, silage etc</p> | <p>Rangeland</p> <p>Grasses</p> <p>Forages</p> <p>Silos</p> |
| | General Objective 2: Know the processes involved in hay making | | | | | |
| 3 | <p>2.1 Identify the equipment and tools required in hay making.</p> <p>2.2 Describe the effects of the climatic and other environmental factors on hay making.</p> <p>2.3 Describe all the operations in producing hay like harvesting, curing, windrowing, storage, utilization etc..</p> | <p>Explain the effects of the climatic and other environmental factors on hay making.</p> <p>Explain all the operations in producing hay like harvesting, curing,</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the equipment and tools required in hay making.</p> <p>Identify hay quality and various grades.</p> | <p>Guide students to: Identify the equipment and tools required in hay making.</p> | <p>Rangeland</p> <p>Grasses</p> <p>Forages</p> <p>Silos</p> |

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| | <p>2.4 Describe hay quality and Identify various grades.</p> <p>2.5 Carry out the hay producing operations in 2.3 above.</p> | windrowing, storage, utilization etc | | Carry out hay producing operations | Identify hay quality and various grades. Carry out hay producing operations | |
| General Objective 3: Know the processes involved in silage making | | | | | | |
| 7 | <p>3.1 Identify the equipment / machinery used in silage making and maintenance.</p> <p>3.2 Explain the climatic and other environmental factors that affect silage making and crop mixtures.</p> <p>Identify crop and crop mixture suitable for silage making.</p> <p>Describe all the operations involved in silage making like harvesting and chopping of silage crop, ensilage process and mechanism of fermentation.</p> <p>Identify silage quality and grading criteria.</p> <p>Make silage applying the operations in 3.4 above.</p> | <p>Explain the climatic and other environmental factors that affect silage making and crop mixtures</p> <p>Explain all the operations involved in silage making like harvesting and chopping of silage crop, ensiling process and mechanism of fermentation</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the equipment or machinery used in silage making silo construction and maintenance.</p> <p>Identify crop and crop mixture suitable for silage making.</p> <p>Identify silage quality and grading criteria.</p> <p>Make silage applying the operations necessary</p> | <p>Guide students to:</p> <p>Identify the equipment or machinery used in silage making silo construction and maintenance</p> <p>Identify crop and crop mixture suitable for silage making.</p> <p>Identify silage quality and grading criteria.</p> <p>Make silage applying the operations necessary</p> | <p>Rangeland</p> <p>Grasses</p> <p>Forages</p> <p>Silos</p> |

| General Objective 4: Acquire skills in strategies use of conserved fodder | | | | | | |
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| 9 | <p>Identify the conditions under which the different conserved fodder could be used.</p> <p>Explain the benefits of the use of the conserved fodder</p> <p>Explain the possible ways of combining the conserved fodder with other feedstuff to meet animal nutrient requirement</p> | <p>Explain the benefits of the use of the conserved fodder</p> <p>Explain the possible ways of combining the conserved fodder with other feedstuff to meet animal nutrient requirement</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the conditions under which the different conserved fodder be used.</p> | <p>Guide students to identify the conditions under which the different conserved fodder be used.</p> | <p>Rangeland</p> <p>Grasses</p> <p>Forages</p> <p>Silos</p> |
| General Objective 5: Know the economics of hay and silage making | | | | | | |
| 13 | <p>5.1 Describe the input and output indices of fodder conservation</p> <p>5.2 Describe the prospects of distribution, demands, supply and marketing of conserved fodder</p> | <p>Explain the input and output indices of fodder conservation</p> <p>Explain the prospects of distribution, demands, supply and marketing of conserved fodder</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Identify the input and output indices of fodder conservation</p> | <p>Guide students to identify the input and output indices of fodder conservation</p> | <p>Rangeland</p> <p>Grasses</p> <p>Forages</p> <p>Silos</p> |

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| | Department/ Programme: | Course Code: | | Credit Hours: |
| | Subject/Course: HORSE RIDING AND MANAGEMENT | PRM 414 | | Theoretical: hours/week |
| | Year: Semester: | Pre-requisite: | | Practical: hours /week |

GOAL: This course is designed to enable the student know the importance of horses in range patrol and management

General Objectives

Know the purpose of range patrol

Know the use of horses for range patrol

Know how to manage the horse

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| | Course: HORSE RIDING AND MANAGEMENT | Course Code: PRM 414 | | Credit Hours: | | |
| | | | | Theoretical: 2 hours/week | | |
| | Year: II Semester: I | Pre-requisite: | | Practical: 3 hours /week | | |
| | Theoretical Content | | Practical Content | | | |
| | General Objective 1.0 Know the purpose for range patrol | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | 1.1 Explain the purpose of range patrol 1.2 Explain different methods of range patrol e.g. Use of aircraft, vehicles, motorcycles etc | Explain purpose of range patrol, methods of range patrol, types of vehicles and animals used | marker board -charts -overhead projector -slide projector | Identify reason for range patrol List the means of range patrol | Guide students to trace the beacons and demarcation of rangeland | Range land |
| | General Objective 2.0 Know the use of hoses for range patrol | | | | | |

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| 2 | <p>Identify various breeds of horses. Identify parts of the horse Identify horse riding equipments e.g. saddle; bridle etc. Identify horse riding gears. Identify other horse upholstery Saddle and bridle a horse. Mount a horse.</p> | <p>Explain horses and horse riding</p> | <p>marker board -charts -overhead projector -slide projector</p> | <p>Identify various breeds of horses. Identify parts of the horse Identify horse riding equipments e.g. saddle; bridle etc. Identify horse riding gears. Identify other horse upholstery Saddle and bridle a horse. Mount a horse.</p> | <p>Guide students to ride horses perfectly</p> | <p>Horses and Accessories Riding Fields</p> |
| 3 | General Objective 3: Know how to manage the horse | | | | | |
| | <p>Identify the peculiarities of horse housing. Identify horse feeding and watering equipment. List common horse ailments e.g. bloat colic, lameness, impaction etc. Identify sick horse Feed horses Bath horses Grooming horses Walk horses in and out of stable Gird horses for mounting Clean horse stable Mount and ride horse through the range</p> | <p>Explain how to : Identify the peculiarities of horse housing. Identify horse feeding and watering equipment. List common horse ailments Identify sick horse Feed horses Bath horses Grooming horses Walk horses in and out of stable Gird horses for mounting Clean horse stable Mount and ride horse through the range</p> | <p>marker board -charts -overhead projector -slide projector</p> | <p>Identify the peculiarities of horse housing. Identify horse feeding and watering equipment. List common horse ailments Identify sick horse Feed horses Bath horses Grooming horses Walk horses Gird horses for mounting Clean horse stable</p> | <p>Guide students to ride and take care of horses perfectly</p> | <p>Horses and Accessories Riding Fields Feeds Cleaning accessories</p> |

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| | Department/ Programme: | Course Code: | | Credit Hours: 3 |
| | Subject/Course: RANGE INVENTORY AND EVALUATIONS | PRM 421 | | Theoretical: hours/week 2 |
| | Year: II Semester: II | Pre-requisite: | | Practical: hours /week 3 |

GOAL: Determine existing condition and identify major problems and pathways for sustainable use

General Objectives

Know the techniques of determining productivity of rangelands

Know how to classify land systems suited for development

Know the indicators of the different conditions of a rangeland

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| | Course Code: PRM 421 | | Credit Hours: | | | |
| | Course: RANGE INVENTORY AND EVALUATIONS | | Theoretical: 2 hours/week | | | |
| | Year: II Semester: II | Pre-requisite: | Practical: 3 hours /week | | | |
| | Theoretical Content | | | Practical Content | | |
| | General Objective 1: Know the techniques of determining productivity of rangelands | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | 1.1 Define the ecosystem concept 1.2 Identify and describe components of the ecosystem including producers, decomposers, consumers and abiotic components. 1.3 Explain the concept of sampling in range studies. 1.4 Describe various sampling methods including strategies, random, systematic sampling. 1.5 Describe parameters/indices used in sampling including cover, canopy, spread, dry matter yield, | Explain the ecosystem concept Explain the concept of sampling in range studies. Explain various sampling methods including strategies, random, systematic sampling. Explain parameters/indices used in sampling including cover, canopy, spread, dry matter yield, species composition, | marker board -charts -overhead projector -slide projector | Identify the components of the ecosystem including producers, decomposers, consumers and abiotic components. | Guide students to identify the components of the ecosystem including producers, decomposers, consumers and abiotic components | Rangeland Grasses Forages Silos |

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| | species composition, density, composition of yield etc. | density, composition of yield etc. | | | | |
| General Objective 2.0: Know how to classify land systems suited for development | | | | | | |
| 7 | <p>2.1 Define range condition trends</p> <p>2.2 Classify land systems suited for development</p> <p>2.3 Collate data obtained on land systems to appraise existing condition and describe trend</p> | <p>Explain range condition trends</p> <p>.</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Classify land systems suited for development</p> <p>Collate data obtained on land systems to appraise existing condition and describe trend</p> | <p>Guide students to:</p> <p>Classify land systems suited for development</p> <p>Collate data obtained on land systems to appraise existing condition and describe trend</p> | <p>Rangeland Maps</p> <p>Markers</p> <p>.</p> |
| General Objective 3.0: Know the indicators of the different conditions of a rangeland | | | | | | |
| 9 | <p>List the indicators of the different range conditions, eg invaders, bare/patch.</p> <p>Identify the indicators in 3.1 above.</p> <p>Describe the process field mapping and vegetation distribution pattern in rangeland.</p> <p>Describe land capability classes and management plans.</p> | <p>Explain:</p> <p>The indicators of the different range conditions, eg invaders, bare/patch.</p> <p>The process field mapping and vegetation distribution pattern in rangeland.</p> <p>The land capability classes and management plans.</p> | <p>marker board</p> <p>-charts</p> <p>-overhead projector</p> <p>-slide projector</p> | <p>Translate range conditions into field maps and vegetation distribution patter.</p> <p>Indicate land capability classes and indicate management plans</p> | <p>Guide students to translate range conditions into field maps and vegetation distribution patter.</p> <p>Indicate land capability classes and indicate management plans</p> | <p>Rangeland Maps</p> <p>Markers</p> |

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| | <i>Department/ Programme:</i> | Course Code: | | Credit Hours: 2.0 |
| | Subject/Course: FORAGE-ANIMAL STRESSES IN PASTURES AND RANGELANDS | PRM 422 | | Theoretical: hours/week 2 |
| | Year: Semester: | Pre-requisite: | | Practical: hours /week 3 |

GOAL: Know common health-related issues encountered in grazing ecosystems

General Objectives

Know the common stresses and their significance in range productivity

Know the causes of stress in free grazing animals.

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|---------------|--|--|---|--|--|----------------------------|
| | Course Code: PRM 422 | | Credit Hours: | | | |
| | Course: FORAGE-ANIMAL STRESSES IN PASTURES AND RANGELANDS | | Theoretical: 2 hours/week | | | |
| | Year: II Semester: II | Pre-requisite: | | Practical: 3 hours /week | | |
| | Theoretical Content | | | Practical Content | | |
| | General Objective 1.0 Know the common stresses and their significance in range animal productivity | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | 1.1 Explain Stress 1.2 Identify possible causes of stress in animals 1.3 Identify animals under stress 1.4 Describe mechanical injury, physical impaction, toxicity, mineral imbalances, parasitic infections and metabolic disorders | Explain: Stress Mechanical injury, physical impaction, toxicity, mineral imbalances, parasitic infections and metabolic disorders The role of the factors in 1.4 above in causing stress in animals | marker board -charts -overhead projector -slide projector Posters | Identify possible causes of stress in animals Identify animals under stress | Guide students to: Identify possible causes of stress in animals Identify animals under stress | Various animals Posters |

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| | 1.5 Explain the role of the factors in 1.4 above in causing stress in animals 1.6 Explain the impacts of stress on productivity and value of rangeland. | The impacts of stress on productivity and value of rangeland. | | | | |
| General Objective 2.0 Know the causes of stress in free grazing animals | | | | | | |
| 2 & 3 | List physical factors that predispose free ranging animals to injures, impaction Identify common poisonous plant Explain the toxic principles in poisonous plants Describe the different types of metabolic disorders in grazing animals e.g. nitrate poisoning, bloat, grass tetany etc | Explain the physical factors that predispose free ranging animals to injures, impaction Explain the toxic principles in poisonous plants Explain the different types of metabolic disorders in grazing animals e.g. nitrate poisoning, bloat, grass tetany etc | marker board -charts -overhead projector -slide projector | Identify common poisonous plant | Guide students to identify common poisonous plant | Various plants and animals Posters |

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|--|--|-----------------------|--|----------------------------------|
| | Department/ Programme: | Course Code: | | Credit Hours: 2 |
| | Subject/Course: CROP RESIDUES MANAGEMENT | PRM 423 | | Theoretical: hours/week 2 |
| | Year: II Semester: II | Pre-requisite: | | Practical: hours /week 3 |

GOAL: This course is designed to enable the student to know the significance of the various crop residues in animal production

General Objectives

Know the various types and forms of crop residues

Know the characteristics of crop residues

Know the various methods/techniques of enhancing quality and handling of crop residues

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|---------------|---|---|--|--|--|-----------------------|
| | Course: CROP RESIDUES MANAGEMENT | Course Code: PRM 423 | | Credit Hours: | | |
| | | | | Theoretical: 2 hours/week | | |
| | Year: II Semester: II | Pre-requisite: | | Practical: 3 hours /week | | |
| | Theoretical Content | | Practical Content | | | |
| | General Objective 1.0 Know the various types and forms of crop residues | | | | | |
| Week/s | Specific Learning Objectives | Teacher's activities | Resources | Specific Learning Objectives | Teacher's activities | Resources |
| 1 | 1.1 Explain crop residues 1.2 Identify crop residues from the various crops cultivated in the various ecological zones of the country 1.3 Explain the differences between farm and agro-processing generated crop residues, emphasizing quality, availability and pricing 1.4 Identify the various farm and agro processing generated crop residues. 1.5 Determine the nutritional contents of the residues | Explain crop residues Explain the differences between farm and agro-processing generated crop residues, emphasizing quality, availability and pricing Identify the various farms and agro processing generated crop residues. | marker board -charts -overhead projector -slide projector | Identify crop residues from the various crops cultivated in the various ecological zones of the country Identify the various farm and agro processing | Show students samples of crop residues | Crop residues Maps |

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| | | Determine the nutritional contents of the residues listed in 1.4 above | | generated crop residues. Determine the nutritional contents of the residues | | |
| General Objective 2.0 Know the characteristics of residues | | | | | | |
| 2 | List the different physical characteristics of crop residues in 1.4 above Describe the physical and chemical criteria for assessing the quality of residues. Assess the quality of residues. | Explain the different physical characteristics of crop residues in 1.4 above Explain the physical and chemical criteria for assessing the quality of residue. | marker board -charts -overhead projector -slide projector | Assess the quality of crop residues. | Show students how to assess the quality of crop residues. | Crop residues Maps |
| General Objective 3.0 Know the various methods/techniques of enhancing quality and handling of crop residues | | | | | | |
| 3 | 3.1 List the different techniques of enhancing quality of crop residues 3.2 Describe the principles and techniques used in enhancing quality of crop residues such as chopping, grinding, pelleting, urea treatment, heat treatment, nutrient/feed supplementation 3.3 Enhance the quality of crop residues for use by animals. | Explain the different techniques of enhancing quality of crop residues Explain the principles and techniques used in enhancing quality of crop residues such as chopping, grinding, pelleting, urea treatment, heat treatment, nutrient/feed supplementation | marker board -charts -overhead projector -slide projector | Identify how to enhance the quality of crop residues for use by animals. | Show students how to enhance the quality of crop residues for use by animals. | Crop residues Maps . |

**TEAM LIST
PASTURE AND RANGE MANAGEMENT (HND) WORKSHOP**

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