

**सबै उप-समूहका बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7) पद/तहको
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम एवं परीक्षा योजना**

यस पाठ्यक्रम योजनालाई दुई चरणमा विभाजन गरिएको छ ।

प्रथम चरण: लिखित परीक्षा (Written Examination)

पूर्णाङ्क: १००

द्वितीय चरण: अन्तरवार्ता (Interview)

पूर्णाङ्क: २०

१. प्रथम चरण (First Phase): लिखित परीक्षा (Written Examination)

पूर्णाङ्क: १००

पत्र	विषय	पूर्णाङ्क	उत्तिर्णाकं	परीक्षा प्रणाली	प्रश्न संख्या x अंक	समय
I	Technical Subject (Related Subgroup)	१००	४०	बस्तुगत बहुवैकल्पिक प्रश्न (MCQs)	२५ प्रश्न x १ अंक = २५ अंक	२ घण्टा
				विषयगत	५ प्रश्न x ५ अंक = २५ अंक ५ प्रश्न x १० अंक = ५० अंक	

२. द्वितीय चरण (Second Phase): Interview

पूर्णाङ्क: २०

विषय	पूर्णाङ्क	परीक्षा प्रणाली
अन्तर्वार्ता	२०	मौखिक

द्रष्टव्य:

- यो पाठ्यक्रम योजनालाई प्रथम चरणमा लिखित परीक्षा र द्वितीय चरणमा अन्तरवार्ता परीक्षा गरी दुई चरणमा विभाजन गरिएको छ ।
- लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुबै हुन सक्ने छ ।
- बस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अंक कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अंक दिइने छैन र अंक कट्टा पनि गरिने छैन ।
- बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको विद्युतीय उपकरण तथा क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।
- बस्तुगत बहुवैकल्पिक प्रश्न (MCQs) को लागि एक उत्तरपुस्तिका हुनेछ । विषयगत प्रश्नका हकमा Short Answer को लागि एक र Long Answer को लागि एक वटा उत्तरपुस्तिका हुनेछ ।
- प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन् । परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नु पर्नेछ ।
- यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयबस्तुमा जेसुकै लेखिएको भएतापनि पाठ्यक्रममा परेका कानून, ऐन, नियम, विनियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाइएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ ।

८. प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवाहरुलाई मात्र द्वितीय चरणको अन्तरवार्तामा सम्मिलित गराइनेछ ।
९. प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारको प्रामाङ्क र द्वितीय चरणको अन्तरवार्तामा प्राप्त गरेको अंक, शैक्षिक योग्यताको अंक र अनुसन्धानात्मक कृतिको अंक जोडी योग्यताक्रम अनुसार सिफारिस गरिनेछ ।
१०. यो पाठ्यक्रम तुरुन्त लागू हुनेछ
११. यस भन्दा अगाडि लागू भएको पाठ्यक्रम खारेज गरिएको छ ।

NARC पदपूर्ति सम्मिति

वरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), एग्रोनोमी उपसमूहको आन्तरिक
प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
For Sub Faculty - Agronomy

1. Crop Production

Rice, wheat, maize, finger millet, barley, buckwheat, legumes, oil seed and cash crops in relation to

- 1.1 Introduction
- 1.2 Origin
- 1.3 Popular recommended varieties
- 1.4 Cultural practices-land preparation, seed treatment, seed rate, planting method /time interculture operations, harvesting, drying, cleaning, and storage
- 1.5 Weed and weed control
- 1.6 Manuring and fertilization: recommended dose, method of application, time of application
- 1.7 Water management: time and frequency of water application, irrigation methods, water requirement, drainage
- 1.8 Economics of major crop productions (rice, maize, wheat, sugarcane, lentil, rapeseed)
- 1.9 Plant protection measures: causal agent, symptoms and control measures and IPM and its importance

2. Tillage

- 2.1 Objectives of tillage
- 2.2 Modern concepts of tillage (zero tillage, minimum tillage) and resource conservation technologies
- 2.3 Use of farm implements to minimize the cost of production

3. Weed Management

- 3.1 Weed classification based on morphology
- 3.2 Loss caused by weeds
- 3.3 Common weeds of major field crops
- 3.4 Weed control measures: cultural, biological and chemical
- 3.5 Herbicides: classification, formulation and mode of action

4. Climate and Crop Production

- 4.1 Temperature (maximum, minimum, optimum and cardinal), solar radiation, precipitation (rainfall), humidity, wind and its direction and velocity
- 4.2 Climate and agro-climatic zones of Nepal
- 4.3 Importance of weather and climate in crop production

5. Soil and Nutrient Management

- 5.1 Soil: definition, soil and sub-soil
- 5.2 Soil texture, soil structure, soil bulk density
- 5.3 Soil of Nepal and its classification
- 5.4 Essential plant nutrients and their sources
- 5.5 Role of essential nutrients
- 5.6 Deficiency symptoms due to the lack of major and minor nutrients
- 5.7 Forms of nutrient (element) utilized by plants
- 5.8 Loss of plant nutrient from soil
- 5.9 Chemical fertilizer, composition and chemical formula
- 5.10 Soil pH, its significance, liming
- 5.11 Soil organic matter, its importance, nutrient content of organic manures
- 5.12 Recommended dose of nutrients, method of application and time of application
- 5.13 Soil organisms, functions of soil organisms, ammonification, nitrification, denitrification, nitrogen fixation
- 5.14 Green manures: green manuring crops, green leaf manuring and constraints of green manuring

6. Cropping Patterns, Farming System and Out-reach Research

- 6.1 Sole, mixed, inter- and sequential cropping: concept and practice in Nepal
- 6.2 Integrated farming system: concept, characteristics and scope
- 6.3 Land use and production efficiency, economics of different cropping patterns

7. Seed Production

- 6.1 Principle and practice of seed production
- 6.2 Types of seeds produced in Nepal, its characteristics and agencies involved
- 6.3 Seed certification and its importance
- 6.4 Principles of seed storage and its use

8. Statistics

- 7.1 Mean, variance, standard deviation, standard error, normal distribution, t-tests
- 7.2 Tests of significance
- 7.3 Randomized complete block design: randomization, layout, analysis of variance, data interpretation
- 7.4 Split-plot design: randomization, analysis of variance, interaction of factors
- 7.5 Simple/multiple-linear regression and correlation

वरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), एग्रोनोमी, प्लाण्ट ब्रिडिङ एण्ड जेनेटिक्स उपसमूहको आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Agronomy, Plant Breeding and Genetics

A. Agronomy

1. Crop Production

Rice, wheat, maize, finger millet, barley, buckwheat, lentil, soybean, pigeon pea, rapeseed, juts and sugarcane in relation to

1.10 Introduction

1.11 Origin (major crops)

1.12 Popular recommended varieties

1.13 Cultural practices-land preparation, seed treatment, seed rate, planting method /time, interculture, harvesting, drying, cleaning, and storage.

1.14 Weed and weed control

1.15 Manuring and fertilization-recommended dose, method of application, time of application

1.16 Water management-time and frequency of water application, irrigation methods, water requirement, drainage

1.17 Economics of major crop productions (rice, maize, wheat, sugarcane, lentil, rapeseed).

1.18 Plant protection measures- causal agent, symptoms and control measures

1.19 IPM and its importance

2. Tillage

2.4 Objectives of tillage

2.5 Modern concepts of tillage, (zero tillage, minimum tillage) resource conservation technologies

2.6 Use of farm implements to minimize the cost of production

3. Weed Management

3.6 Loss caused by weeds

3.7 Weed classification based on morphology

3.8 Common weeds in major field crops

3.9 Weed control measures: cultural, biological and chemical

3.10 Herbicides - classification of herbicides, herbicide formulation

4. Climate and Crop Production

4.4 Temperature (maximum and minimum)

- 4.5 Solar radiation
- 4.6 Sunlight
- 4.7 Precipitation (rainfall)
- 4.8 Relative humidity
- 4.9 Wind and its velocity

- 4.10 Climate of Nepal-climatic zones
- 4.11 Importance of climate in crop production

5. Soil and Nutrient Management

- 5.15 Soil definition, soil and sub-soil
- 5.16 Soil texture, soil structure, soil bulk density
- 5.17 Soil of Nepal and classification
- 5.18 Essential plant nutrients and their sources
- 5.19 Role of essential nutrients
- 5.20 Deficiency symptoms due to the lack of major and minor nutrients
- 5.21 Forms of nutrient (element) utilized by plants
- 5.22 Loss of plant nutrient from soil
- 5.23 Chemical fertilizer, composition and chemical formula
- 5.24 Soil pH, its significance, liming
- 5.25 Soil organic matter, its importance, nutrient content of animal dung
- 5.26 Recommended dose of nutrients, method of application and time of application
- 5.27 Soil organisms, functions of soil organisms, ammonification, nitrification, denitrification, nitrogen fixation
- 5.28 Green manures - Green manuring crops, green leaf manuring and constraints of green manuring
- 5.29 Farming systems, its concept and scope, outreach research and on-farm trials

6. Seed Production

- 6.5 Principle and practice of seed production
- 6.6 Seed certification and its importance
- 6.7 Seed storage for further use

7. Statistics

- 7.6 Mean, variance, standard deviation, standard error, normal distribution, t-tests
- 7.7 Tests of significance
- 7.8 Randomized complete block design, layout, randomization, analysis of variance, data interpretation
- 7.9 Split-plot design- randomization, analysis of variance, interaction of factors
- 7.10 Simple/multiple-linear regression and correlation

B. Plant Breeding

1. Definition, importance, history and achievement of plant breeding
2. Center of origin of cultivated plants
3. Heredity, qualitative and quantitative characters
4. Breeding self-pollinated crops
 - 4.1 Pure-line selection
 - 4.2 Mass selection
 - 4.3 Hybridization
 - 4.3.1 Pedigree method of plant breeding
 - 4.3.2 Bulk-method of plant breeding
 - 4.3.3 Back-cross method
 - 4.3.4 Choice of parents, Growing of Generation Lines, F₁, F₂, F₃, F₄, F₅, F₆ and selections
 - 4.3.5 The determination of populations in F₂
5. Breeding cross-pollinated crops
 - 5.1 Mass selection
 - 5.2 Progeny selection
 - 5.3 Simple recurrent selection
 - 5.4 Recurrent selection for general combining ability
 - 5.5 Recurrent selection for specific combining ability
 - 5.6 Incompatibility
 - 5.7 Male sterility
6. Inbreeding depression, hybrid varieties
7. The dominance and over dominance theory of heterosis
8. Polyploidy in plant breeding
9. Mutation breeding
10. Principles and practices of seed production
11. Production of breeder seed and foundation seed of major crops

C. Genetics

1. Cell division with particular reference to meiosis
2. Gregor Mendel's life and contribution
3. Mendelian principle of segregation
4. Mendelian principle of independent assortment
5. Epistasis and additivity
6. Linkage and crossing over
7. Hardy-Weinberg Law
8. Probability and statistical testing (Chi-square, Binomial Distributions and Normal Distributions)

D. Others

1. Nepal Agricultural Research Council: Establishment, objectives, role and activities
2. By-laws of NARC, Executive Board and Council
3. Major crop commodity program, establishment, and activities
4. Disciplinary Divisions and their roles in research
5. Agriculture Development Strategy (ADS) and current plan
6. Constraints for agricultural research; a road map to the improvement and sustainability of agriculture research

---****---

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), प्लाण्ट ब्रिडिङ एण्ड जेनेटिक्स
उपसमूहको आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Plant Breeding and Genetics

A. Plant Breeding

12. Definition, importance, history and achievement of plant breeding
13. Center of origin of cultivated plants
14. Heredity, qualitative and quantitative characters
15. Breeding self-pollinated crops
 - 4.4 Pure-line selection
 - 4.5 Mass selection
 - 4.6 Hybridization
 - 4.6.1 Pedigree method of plant breeding
 - 4.6.2 Bulk-method of plant breeding
 - 4.6.3 Back-cross method
 - 4.6.4 Choice of parents, Growing of Generation Lines, F₁, F₂, F₃, F₄, F₅, F₆ and selections
 - 4.6.5 The determination of populations in F₂
16. Breeding cross-pollinated crops
 - 5.8 Mass selection
 - 5.9 Progeny selection
 - 5.10 Simple recurrent selection
 - 5.11 Recurrent selection for general combining ability
 - 5.12 Recurrent selection for specific combining ability
 - 5.13 Incompatibility
 - 5.14 Male sterility
17. Inbreeding depression, hybrid varieties
18. The dominance and over dominance theory of heterosis
19. Polyploidy in plant breeding
20. Mutation breeding

B. Genetics

9. Cell division with particular reference to meiosis
10. Gregor Mendel's life and contribution
11. Mendelian principle of segregation
12. Mendelian principle of independent assortment
13. Epistasis and additivity
14. Linkage and crossing over
15. Hardy-Weinberg Law

16. Probability and statistical testing (Chi-square, Binomial Distributions and Normal Distributions)

C. Seed Production

- 6.8 Principle and practice of seed production
- 6.9 Types of seeds produced in Nepal, its characteristics and agencies involved
- 6.10 Seed certification and its importance
- 6.11 Principles of seed storage and its use

D. Statistics

- 7.11 Mean, variance, standard deviation, standard error, normal distribution, t-tests and tests of significance
- 7.12 Randomized complete block design, layout, randomization, analysis of variance, data interpretation
- 7.13 Split-plot design-randomization, analysis of variance, interaction of factors
- 7.14 Simple/multiple-linear regression and correlation

E. Others

- 7. Nepal Agricultural Research Council: Establishment, objectives, role and activities
- 8. By-laws of NARC, Executive Board and Council
- 9. Major crop commodity program, establishment, and activities
- 10. Disciplinary Divisions and their roles in research
- 11. Agriculture Development Strategy (ADS), current plan and policies
- 12. Constraints for agricultural research; a road map to the improvement and sustainability of agriculture research

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), एग्री इक्सटेन्शन एग्री ईकोनोमिक्स
एण्ड मार्केटिङ उपसमूहको आन्तरीक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject

Sub Group: Agri Extension Agri Economic and Marketing

1. General Economic Theories

- 1.1 Theory of Consumer Behavior
 - 1.1.1 Marginal Utility Analysis
 - 1.1.2 Indifference Curve Analysis
 - 1.1.3 Revealed Preference Theory
- 1.2 Elasticity of Demand and Supply
- 1.3 Income and Substitution Effects
- 1.4 Classification of Markets and their critical Appraisal
- 1.5 Price Determination in Different Market conditions
- 1.6 Production function and Principles of Production
- 1.7 Cost: Concept and Types
- 1.8 Welfare Economics: Concept of Consumer's surplus, Producer's surplus and Pareto Optimality

2. Agricultural Economics

- 2.1 Characteristics of farming as a business
- 2.2 Tools of Farm Management Analysis
 - 2.2.1 Farm Planning
 - 2.2.2 Farm Budgeting
- 2.3 Farm Business Analysis
 - 2.3.1 Farm Records and Accounts
 - 2.3.2 Farm Inventory: Valuation and Depreciation Techniques
- 2.4 Cost and Return Analysis of Different Crops

3. Agricultural Marketing

- 3.1 Role of Agricultural marketing in economic and agricultural development
- 3.2 Problems and prospects of agricultural marketing in Nepal
- 3.3 Input and output marketing system
- 3.4 Agricultural Marketing Research: Concept and Role
- 3.5 Marketing Information System in Nepal
- 3.6 Group and cooperative Marketing in Nepal
- 3.7 Development and Management of Agricultural Market Centers in Nepal.
- 3.8 Agricultural Marketing and Price Policies in Nepal
- 3.9 Global and Regional organizations for Marketing and Trade (WTO, SAFTA)

4. Agribusiness

- 1.1 Concept and role
- 1.2 Grading, packaging, standardization: present situation in Nepal
- 1.3 International trade analysis
- 1.4 Agribusiness development process of new technologies

5. Agricultural Planning

- 5.1 Concept of research planning, project, project cycle, programming and budgeting
- 5.2 Research technology analysis
 - 5.2.1 Financial and Economic Aspects
 - 5.2.2 Socio economic impact of technology
- 5.3 Concept and Methods of Monitoring and Evaluation
- 5.4 Market-oriented production planning
- 5.5 Technology scaling up strategies
- 5.6 Participatory research planning
- 5.7 Environmental impact assessment of new technologies

6. Agricultural Research Institutions in Nepal

- 8.1 Role of NARC in Technology Generation
- 8.2 NARC-Present status and future prospects
- 8.3 GOs, Universities, NGOs and INGOs

7. Public Resource Allocation and Organizational Development in Nepal

- 7.1 Trend in resource allocation for agricultural development in general and agricultural research in particular.
- 7.2 Role of Foreign Aid in Agricultural Development: Issues and Prospects
- 7.3 History of agricultural research and development

8. Statistics

- 8.1 Measures of Central Tendency : Mean, Median, Mode, Harmonic Mean, Geometric Mean
- 8.2 Measures of Dispersion: Variance, mean and standard deviation.
- 8.3 Probability: normal distribution, standard sampling error, test of hypothesis
- 8.4 Correlation analysis
- 8.5 Simple linear regression
- 8.6 Simple and Weighted index numbers
- 8.7 Sampling Techniques
- 8.8 Determination of Sample size

9. Others

- 9.1 Role of agriculture in Nepalese economy
- 9.2 Structural characteristics of Nepalese Agriculture
- 9.3 Long-term and periodic plans and policies on agricultural development
- 9.4 Problems and prospects of agricultural research and development in Nepal

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), एग्री ईन्जिनियरिङ उपसमूहको
आन्तरीक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Agri-Engineering

2. Soil and water Engineering

2.1 Irrigation Water Measurement Methods

- 1.1.1 Weirs
- 1.1.2 Parshal flume
- 1.1.3 Cut throat flumes
- 1.1.4 Orifices and meter gates
- 1.1.5 Tracer method
- 1.1.6 Velocity area method

2.2 Water Conveyance and Control

- 1.2.1 Open channel
- 1.2.2 Design of open channel
- 1.2.3 Channel linings
- 1.2.4 Drop structures and spillways
- 1.2.5 Water control and division structures
- 1.2.6 Cross drainage structures
- 1.2.7 Pipe flow
- 1.2.8 Design of pipe conveyance system
- 1.2.9 Underground pipe conveyance system

2.3 Land Development

- 1.3.1 Land leveling and grading methods
- 1.3.2 Estimation of earthwork quantities
- 1.3.3 Equipment for land grading and field layout
- 1.3.4 Laser leveling

2.4 Soil-Plant and Water Relationships and Irrigation Requirements

- 1.4.1 Types of soil and Soil water
- 1.4.2 Movements of water in soil-plant-environment continuum
- 1.4.3 Soil moisture tension
- 1.4.4 Measurement of soil moisture
- 1.4.5 Plant water relationship
- 1.4.6 Evaporation, transpiration and consumptive use
- 1.4.7 Evapotranspiration (ET) estimation methods
- 1.4.8 Water requirements

- 1.4.9 Irrigation efficiency
- 1.4.10 Irrigation scheduling and water management of major crops viz. rice, wheat, maize, sugarcane

2.5 Water Application Methods and its Design

- 1.5.1 Border irrigation
- 1.5.2 Check basin irrigation
- 1.5.3 Furrow Irrigation
- 1.5.4 Sprinkler Irrigation
- 1.5.5 Drip Irrigation
- 1.5.6 Sub-surface irrigation

2.6 Agricultural Drainage

- 1.6.1 Surface drainage system
- 1.6.2 Subsurface drainage system
- 1.6.3 Design of surface and subsurface drainage

2.7 Ground Water and Irrigation Wells

- 1.7.1 Ground water occurrence and distribution
- 1.7.2 Aquifers and their properties
- 1.7.3 Hydraulics of wells
- 1.7.4 Design of wells
- 1.7.5 Wells construction procedures
- 1.7.6 Testing of wells

2.8 Irrigation Pumps

- 1.8.1 Indigenous water lifting devices
- 1.8.2 Positive displacement pumps
- 1.8.3 Centrifugal Pumps
- 1.8.4 Vertical Turbine Pumps
- 1.8.5 Submersible Pumps
- 1.8.6 Propeller and mixed flow pumps
- 1.8.7 Selection of pumps
- 1.8.8 Power requirement, efficiency and economics of irrigation pumping system

2.9 Engineering Hydrology

- 1.9.1 Hydrological cycle
- 1.9.2 Measurement and analysis of precipitation and runoff
- 1.9.3 Measurement, estimation and analysis of runoff
- 1.9.4 Storm hydrograph
- 1.9.5 Sediment transport

2.10 Soil and Water Conservation

- 1.10.1 Water erosion (Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion, Stream channel erosion)
- 1.10.2 Soil losses and its measurement
- 1.10.3 Erosion control measures (agricultural, engineering, bioengineering methods)
- 1.10.4 Terrace and vegetated waterway and farm pond design
- 1.10.5 Conservation structures
- 1.10.6 Watershed management

3. Farm Power and Machinery

3.1 Farm Power and Energy

- 2.1.1 Human power
- 2.1.2 Animal Power
- 2.1.3 Mechanical power
- 2.1.4 Electrical power
- 2.1.5 Solar and wind energy
- 2.1.6 Biomass energy

3.2 Internal Combustion Engines

- 2.2.1 Petrol, diesel and byfuel engines
- 2.2.2 Engine Parts
- 2.2.3 Principle of operation
- 2.2.4 Engine systems (air cleaning, fuel, lubricating, ignition, cooling, governing system)
- 2.2.5 Performance and characteristics of diesel engines

3.3 Farm Tractor and its Operation and Maintenance

- 2.3.1 Farm tractor types
- 2.3.2 Parts and components of farm tractor (engine systems, clutch, power transmission, differentials, final drive, power take off, tractor draw bar and traction devices, steering mechanism, hydraulic system, starting mechanism)
- 2.3.3 Tractor repair and maintenance
- 2.3.4 Farm tractor selection and economics on operation of farm tractor

3.4 Tillage and Tillage Implements

- 2.4.1 Tillage requirements and draft power requirement
- 2.4.2 Tillage implements
- 2.4.3 Traditional animal drawn plough, Mold board plough, Disc plough, Chisel plough, Rotovator, Harrows
- 2.4.4 Minimum and zero tillage implements
- 2.4.5 Testing and selection of tillage implements
- 2.4.6 Operation and maintenance of tillage implements

3.5 Seeding, Harvesting and Threshing Machinery

- 2.5.1 Sowing methods of major crops
- 2.5.2 Seed drill and its components
- 2.5.3 Planters and its components
- 2.5.4 Rice transplanters
- 2.5.5 Vertical conveyor reaper and its components
- 2.5.6 Combine harvester
- 2.5.7 Type of threshers
- 2.5.8 Multi-crop thresher
- 2.5.9 Winnowing machine
- 2.5.10 Operation and maintenance of seeding, harvesting and threshing machinery
- 2.5.11 Testing of seeding, harvesting and threshing machinery

3.6 Mechanical Weeding and Chemical Application Equipment

- 2.6.1 Manual and power weeders
- 2.6.2 Sprayers (its types, components, nozzle types, application)
- 2.6.3 Dusters
- 2.6.4 Operation and maintenance of Mechanical weeding and chemical application equipment
- 2.6.5 Testing of Mechanical weeding and chemical application equipment

4. Post Harvest Engineering

4.1 Grain Drying

- 3.1.1 Grain drying needs
- 3.1.2 Grain drying methods
- 3.1.3 Grain drying theory (thin layer and deep layer drying)
- 3.1.4 Mechanical dryers (batch and continuous type)
- 3.1.5 Energy requirement in drying
- 3.1.6 Efficiency of dryers (fuel, thermal and drying efficiency)

4.2 Rice Processing

- 3.2.1 Traditional rice milling
- 3.2.2 Rice hulling, shelling and polishing
- 3.2.3 Rice parboiling and Beaten rice making
- 3.2.4 Equipment used in rice processing
- 3.2.5 Testing of rice processing equipment

4.3 Processing of Wheat, Maize, Legumes and Oilseed

- 3.3.1 Milling, Hulling, Oil expelling
- 3.3.2 Hulling, grinding and oil expelling equipment
- 3.3.3 Testing of hulling, milling and oil expelling equipment

4.4 Processing and Preservation of Seeds and Agricultural Produces

3.4.1 Unit operations

3.4.2 Cold storage

3.4.3 Refrigeration Seed processing equipment and storage

3.4.4 Cellar storage

3.4.5 Dairy machinery (Pasteurization and sterilization, Can washers, Cream separators, Butter churns, Steam boilers)

5. Farm Structures

5.1 Design of Structure and Building Material

4.1.1 Design of RCC structure (beam, slab, foundation and column)

4.1.2 Design of steel and wooden structure (truss, beam and column)

4.1.3 Building materials (concrete, cement, lime, sand, bitumin, surkhi, mud, brick, stone, timber, Mild steel, GI sheet)

4.1.4 Quality test of building materials

5.2 Planning of Farmstead and Farm Structures

4.2.1 Planning of farmstead

4.2.2 Farm residence, Water supply and sanitation, Farm road, Fencing etc.

4.2.3 Design of estimate of above structures

4.2.4 Design and development of plant animal production system in controlled environment

5.3 Animal Shelters

4.3.1 Dairy barn (housing requirements, stanchion barn, loose housing barn, barn equipment and accessories, milking barn, pen barn)

4.3.2 Poultry housing (housing requirement, type of poultry house, brooder house, poultry equipment and accessories)

4.3.3 Sheep and goat housing (types, housing requirements, construction material, layout, equipment and accessories in goat and sheep housing)

4.3.4 Swine housing (types, housing requirements, construction materials, layout, equipment and accessories in swine housing)

5.4 Storage Structures

4.3.5 Animal fodder storage structure

4.3.6 Animal feed storage structure

4.3.7 Food grain storage structure (Indigenous storage structure, Bag storage structure, grain bins, modern godowns)

4.3.8 Grain Pressure theories and design of grain bins

4.3.9 Farm machinery storage structure and farm workshop

5.5 Design and Management of Electric System in the Farm

4.5.1 Electricity distribution needs in agricultural farms

4.5.2 House wiring and its components

4.5.3 Transformer

4.5.4 AC motor (single phase and poly phase)

4.5.5 AC motor starters

4.5.6 Selection of electric motors

4.5.7 Care and maintenance of electric equipment

6. Statistics

6.1 Frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling theory, test of hypothesis

6.2 Design of field experiments

6.3 Analysis of variance

6.4 Regression and correlation (linear regression and correlation, multiple linear regression and correlation)

7. Other

7.1 Establishment of Nepal Agricultural Research Council (NARC), its organizational structures, role and functions

7.2 Agricultural Development Strategy (ADS)

7.3 Irrigation Policy

7.4 Agricultural and irrigation development policies in federal governance architecture

7.5 Status of agricultural mechanization and agricultural mechanization policy

7.6 Agricultural engineering related Institutions in Nepal

—
—

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), ईण्टोमोलोजी उपसमूहको
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Entomology

1. Introductory Entomology

- 1.1 Role of entomology in agriculture
- 1.2 Scope of entomological research in agriculture
- 1.3 Insects and their relatives
- 1.4 General structure of a typical insect
- 1.5 General metamorphosis and life cycle of Lepidoptera, Coleoptera and Hemiptera
- 1.6 Pest insects and beneficial insects
- 1.7 IPM experience in Nepal
- 1.8 IPM : role of GO, NGO and public
- 1.9 LPM and organic agriculture.

2. External Morphology of Insects

- 2.1 Body wall and exoskeleton
- 2.2 Head, appendages of a head, mouth parts, principal types of mouth parts
- 2.3 Thorax, thoracic segment, legs, and wings
- 2.4 Abdomen, appendages, processes, and external genitalia

3. Internal Anatomy and Physiology of Insects

- 3.1 Digestive system: alimentary canal, digestion and absorption
- 3.2 Respiratory system: tracheae, tracheoles and respiration
- 3.3 Circulatory system: blood and its circulation
- 3.4 Excretion system: malpighian tubules and rectum; regulation of dissolved salts and water
- 3.5 Nervous system: central, visceral and peripheral nervous systems
- 3.6 Reproductive system: male reproductive system, female reproductive system, types of reproduction and metamorphosis of insects
- 3.7 Muscular system: cephalic, thoracic abdominal and flight muscles, metabolism and degeneration of muscles
- 3.8 Endocrine system: neurosecretory cells, hormones and pheromones.
- 3.9 Sense organs and perceptions

4. Insect Toxicology

- 4.1 Chemical classification and development of synthetic insecticides
- 4.2 Different formulations
- 4.3 Toxicological parameters

- 4.3.1 Acute oral toxicity, chronic oral toxicity, dermal toxicity, inhalation toxicity, bio-magnification, maximum residue limit, hazards, average daily intake.
- 4.4 Labeling, packing, storage and disposal
- 4.5 Impact of insecticide misuse
- 4.6 Mode of action of organophosphates and carbamates in target organism
- 4.7 Bioassay of insecticide in laboratory
- 4.8 Methods of diluting insecticide to a recommendation level
- 4.9 Safe use of insecticides
- 4.10 Application equipments
- 4.11 Sprayer calibration
- 5. Insect Ecology**
 - 5.1 Trophic relationship
 - 5.2 Population estimates
 - 5.3 Coexistence and competition
 - 5.4 Community and distribution
- 6. Biological Control**
 - 6.1 Natural and biological control
 - 6.2 Biological characteristics of parasitoids, predators and pathogens and their role in nature
 - 6.3 Quarantine handling of entomophagus insects
 - 6.4 Culture of entomophagus insects and their insect hosts
 - 6.5 Insectary facilities and equipments
 - 6.6 Methods of colonisation, recovery and evaluation of natural enemies
 - 6.7 Biological control of insects as a component of IPM
- 7. Host Plant Resistance**
 - 7.1 Resistance mechanisms
 - 7.2 Biotypes and their expression of persistence
 - 7.3 Plant resistance in pest management
- 8. Apiculture and Sericulture**
 - 8.1 Significance of honeybees in agriculture
 - 8.2 Different species of honeybees, their identification, life cycle and division of labour in the colony
 - 8.3 Management of apiary
 - 8.4 Modern beekeeping
 - 8.5 Types of silkworms, their nature and life cycle
 - 8.6 Management of *Bombax mori*, food materials and silk production
 - 8.7 Silkworm diseases and their management

9. Economic Entomology

- 9.1 Important insect pests of cereals, oilseeds and grain legumes, their identification, damage symptoms, life cycle and management.
- 9.2 Important insect pests of potato, vegetables and fruit trees, their identification, damage symptoms, life cycle and management.
- 9.3 Important insect pests of sugarcane, cotton, jute, tea, coffee and cardamom, their identification, damage symptoms, life cycle and management.
- 9.4 Important insect pests of stored grains, their identification, damage symptoms, life cycle and management

10. Project Concept Note Preparation and Entomological Research Methodology

- 10.1 Preparation of project concept note
- 10.2 Research methodology
 - 10.2.1 Insect laboratory and rearing equipments
 - 10.2.2 Green house and insect rearing equipments
 - 10.2.3 Experimental Designs in field and laboratory
 - 10.2.4 Observation techniques
 - 10.2.5 mortality correction
 - 10.2.6 Bioassay
- 10.3 Statistics
 - 10.3.1 Descriptive statistics, Chi-square test, Student t-test
 - 10.3.2 Transformation of data: square root transformation, logarithmic transformation and angular (arc sine) transformation.
 - 10.3.3 Analysis of variation
 - 10.3.4 Mean separation: LSD and Duncan's Multiple Range Test
 - 10.3.5 Probit analysis
 - 10.3.6 Non-parametric analyses

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), ओलरीकल्चर उपसमूहको
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Olericulture

1. Vegetable Production

Production practices of following vegetables relating to location, altitude, aspect, soil, climate, seed, open pollinated & hybrid cultivar, sowing and transplanting time, spacing, irrigation, drainage, manure, fertilizer micro-nutrients, mulching, harvesting time, inter-cropping, mix-cropping and relay-cropping on production, productivity and quality of fresh vegetables

- 1.1 Potato, sweet potato, yam, colocasia
- 1.2 Tomato, brinjal, hot chilly, sweet pepper okra
- 1.3 Cauliflower, cabbage, Chinese cabbage and broccoli
- 1.4 Bean, pea, cowpea, broad bean and vegetable soybean
- 1.5 Radish, turnip and carrot
- 1.6 Onion and garlic
- 1.7 Cucumber, bottle gourd, sponge gourd, bitter melon, pointed gourd, ridge gourd, snake melon, pumpkin and squash
- 1.8 Broad leaf mustard, Swiss chard, cress, spinach, fenugreek, coriander, and lettuce
- 1.9 Ginger, cardamom
- 1.10 Asparagus drum stick and tree tomato

2. Off-season Vegetables Production

- 2.1 Present status, constraints and potentiality of off-season vegetable in Nepal
- 2.2 Utilization of diverse agro-climatic zones for off-season vegetables production
- 2.3 Suitable crops, varieties and months for off-season production
- 2.4 Protected cultivation: Green house, lath house, plastic tunnel, hot beds, cold frame
- 2.5 Improved cultural and management technologies and practices for off-season production
- 2.6 Cost and benefits of off-season vegetable production
- 2.7 Use and misuse of pesticide in vegetables

3. Seed Production Technology

- 3.1 Present status of vegetables seed production and marketing in Nepal
- 3.2 High value with low volume vegetables crops and their production zones of Nepal
- 3.3 Effects of location, aspects, altitude, temperature, light, daylight, spacing irrigation, manures, fertilizers, micro nutrients, hormone, direct seeding, stickling-transplanting, seeding and planting time on seed yield and seed quality
- 3.4 Pollination, fertilization, seed development, dormancy and germination

- 3.5 Technique of quality control in seed production
- 3.6 Seed production methods for open pollinated and hybrid cultivars
- 3.7 Existing vegetable seed production zones of Nepal
- 3.8 Major problems and weakness of vegetable seed research, vegetable seed production and marketing in Nepal
- 3.9 Pre-basic, basic improved/certified seed production in potato and ginger
- 3.10 Breeder, nucleus and foundation seed production in vegetable

4. Post-harvest technology of vegetables

- 4.1 Post harvest physiology- respiration, transpiration and ethylene production
- 4.2 Method of harvesting, cleaning, grading, and packaging
- 4.3 Post harvest handling, transportation and marketing
- 4.4 Consumer's acceptability and quality evaluation of vegetables
- 4.5 Processing and preservation of vegetables, potato, ginger and cardamom
- 4.6 Significance of vegetable quarantine system

5. Modern Technology of vegetable Production

- 5.1 Tissue culture
- 5.2 Use of plant growth regulators in vegetables
- 5.3 Drip and other micro irrigation
- 5.4 Plastic tunnel, plastic house and plastic mulching
- 5.5 Micro-nutrient, multi-nutrient, liquid fertilizers and bio-fertilizers
- 5.6 Latest recommended superior hybrid and superior open pollinated cultivars used by Nepali farmers
- 5.7 Integrated disease and pest management including biological, cultural, pheromone traps
- 5.8 Integrated soil and plant nutrient management
- 5.9 True potato seed and its role in improving potato production technology
- 5.10 Disease free seed potato production
- 5.11 Soil-less vegetable production technology
- 5.12 Good agricultural practices in safe vegetable production

6. Indigenous Technology

- 6.1 Local and wild edible vegetable, species, cultivars and their usefulness
- 6.2 Indigenous practices of vegetable cultivation
- 6.3 Indigenous methods of disease and pest control and preventive measure
- 6.4 Indigenous methods of soil fertility improvement and management
- 6.5 Indigenous methods and management of water conservation and utilization

7. Varietal Improvement

- 7.1 Germplasm collection, evaluation, conservation and utilization.
- 7.2 Selfing, crossing, evaluation and selection of off-springs

- 7.3 Genotypic, phenotypic variation and its heritability
- 7.4 Breeding method in self-pollinated and cross pollinated vegetable crops
- 7.5 Mendalism
- 7.6 Mutation breeding
- 7.7 Variety maintenance of self-pollinated and cross-pollinated crops

8. Research Methods and Management

- 8.1 Research needs in vegetable, potato and ginger
- 8.2 Steps in research project proposal preparation
- 8.3 Design of experiments and its basic characters
- 8.4 Implementation of research activities
- 8.5 Laboratory research
- 8.6 On-station research
- 8.7 On farm research
- 8.8 Outreach research
- 8.9 Farmer's participatory research
- 8.10 Collaborative research
- 8.11 Multi-partnership research
- 8.12 Data base preparation
- 8.13 Data analysis, technical report writing and presentation

9. Biological Statistics

- 9.1 Need of biological statistics for research and researcher
- 9.2 Probability, frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling theory, test of hypothesis, and confidence interval, T-test, F-Test and Chi-square test
- 9.3 Estimate of error: Replication and randomization
- 9.4 Control error: Blocking, proper plot technique and data analysis
- 9.5 Control randomized design: Randomization, layout and analysis of variance
- 9.6 Randomized complete block design: Layout, randomization, analysis of variance
- 9.7 Two or more factorial experiment-randomization, layout, analysis of variance and interaction
- 9.8 Split plot design: Randomization, analysis of variance and interaction of factors
- 9.9 Comparison: Pair comparison by Least Signingicants Different (LSD) and Duncan's Multiple Range Test (DMRT)
- 9.10 Regression and correlation: Simple linear regression and correlation, multiple-linear regression and correlation

10. Others

- 10.1 History, impact and importance of horticultural research and development plans and programs in Nepal
- 10.2 Major horticultural crops in Nepal

- 10.3 Major production constraints of horticultural crops in Nepal
- 10.4 History, objective, role and activities of Nepal Agricultural Research Council (NARC)
- 10.5 Nutritional, economical and environmental value of horticultural crops
- 10.6 Classification of horticultural crops

*

NARC पदपत्र
सहित

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), पोमोलोजी उपसमूहको
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject

Sub-Group: Pomology

1. Fundamentals of Fruit Production

- 1.1 Importance and scope of fruit production in Nepal
- 1.2 Opportunity of fruits development in Nepal
- 1.3 Climate of Nepal
 - 1.3.1 Temperature
 - 1.3.2 Humidity
 - 1.3.3 Pressure
 - 1.3.4 Rainfall
 - 1.3.5 Photoperiod
 - 1.3.6 Soil temperature
 - 1.3.7 Weather observation
 - 1.3.8 Climatic zones and their features in Nepal
 - 1.3.9 Climate change and its effect on fruit farming
- 1.4 Soils of Nepal
 - 1.4.1 Soils of Nepal and their classification
- 1.5 Land resources
 - 1.5.1 Physiographic distribution of Nepal
 - 1.5.2 Land systems, land use and land capability
- 1.6 Factors to be considered during Orchard establishment including site selection, lay out and planting of fruit plants
- 1.7 Nursery management
 - 1.7.1 Propagating structure
 - 1.7.2 Media
 - 1.7.3 Fertilizers
 - 1.7.4 Soil mixtures
 - 1.7.5 Stratification of fruit seeds
 - 1.7.6 Nursery bed preparation
 - 1.7.7 Planting of grafted plants in the beds
- 1.8 Propagation
 - 1.8.1 Sexual propagation
 - 1.8.1.1 Production of genetically pure seeds
 - 1.8.1.2 Techniques of seed production and handling
 - 1.8.1.3 Principles of propagation by seeds
 - 1.8.1.4 Techniques of propagation by seeds
 - 1.8.2 Asexual Propagation

- 1.8.2.1 General aspects of Asexual propagation –importance of asexual propagation, Reasons, production and maintenance of true to type clones, influence of scions in root stocks and influence of root stock on scions
- 1.8.2.2 Different types of rootstocks
- 1.8.2.3 Different types of scions and their methods of collection and preservation for latter use
- 1.8.2.4 Different types of vegetative propagation
 - 1.8.2.4.1 Cuttings
 - 1.8.2.4.2 Grafting
 - 1.8.2.4.3 Budding
 - 1.8.2.4.4 Layering
- 1.8.2.5 Propagation by Specialised stems and roots
- 1.8.2.6 Micro propagation
- 1.8.2.7 Tissue culture
- 1.8.3 Cultural practices
- 1.8.4 Training and pruning of the fruit trees
 - 1.8.4.1 Importance of training and pruning
 - 1.8.4.2 Different methods of training and pruning
 - 1.8.4.3 Effects of pruning on plant growth
- 1.8.5 Problems of Fruiting
- 1.8.6 Plant hormones in fruit crops
- 1.8.7 Mango malformation
- 1.8.8 Citrus decline
- 1.8.9 Post harvest technology for minimizing the post harvest loss

2. Study on Major Fruit Crops like mango, banana, litchi, guava, papaya, aonla, pomegranate, jack fruit, apple, pear, peach, plum, walnut, pecan nut, almond, apricot, cherry, persimmon, avocado, grapes and citrus fruits on the following aspects:

- 2.1 Introduction, origin and distribution
- 2.2 Taxonomy, Morphology and growth stages of plants
- 2.3 Climate and soil
- 2.4 Cultivars requirement
- 2.5 Propagation techniques
- 2.6 Planting method
- 2.7 Cultural practices
- 2.8 Weed control practices
- 2.9 Manures and fertilizers management
- 2.10 Pests and diseases control
- 2.11 Harvesting, storage and marketing

3. Weed and Weed Control

- 3.1 Classification of weeds and their distributions
- 3.2 Importance of weed control in fruit production
- 3.3 Common weeds of fruit orchard
- 3.4 Methods of weed control in fruit orchard

4. Soils and Fertilizers

- 4.1 Soil moisture
- 4.2 Surface tension
- 4.3 Water holding capacity
- 4.4 Water movement in soil
- 4.5 Essential plant nutrients
- 4.6 Functions of macro and micro nutrients and deficiency symptom
- 4.7 Forms of nutrients utilized by plants
- 4.8 Chemical fertilizers- composition, classification and their uses
- 4.9 Process of absorption of nutrients by plant
- 4.10 Determination of nutrient requirements of the soils
- 4.11 Response of N.P.K. in major fruit crops
- 4.12 Soil pH
- 4.13 Liming and liming materials
- 4.14 Organic matters
- 4.15 C: N ratio
- 4.16 Recommended doses of nutrients, time and methods of application
- 4.17 Green manuring
- 4.18 Farm yard manure and compost
- 4.19 Compost preparation

5. Plant Breeding

- 5.1 Definition and importance of plant breeding
- 5.2 Genotypes and phenotypes
- 5.3 Germplasm collection, evaluation and utilization
- 5.4 Maintenance of fruit varieties
- 5.5 Application of biotechnology and tissue culture in fruit crops.

6. Photosynthesis, Respiration and Transpiration

7. Statistics

- 7.1 Mean, median, mode, standard deviation, standard error, frequency, probability, distribution, sampling theory, test of hypothesis, confidence interval
- 7.2 Estimate of error- replication and randomization
- 7.3 Experimental designs and its basic characters

- 7.4 Comparison
- 7.5 Regression and correlation

8. Others

- 8.1 Planning, monitoring and evaluation
- 8.2 Research project proposal preparation
- 8.3 Motivation and development
- 8.4 How to be a successful scientist in Nepalese condition
- 8.5 Report writing
- 8.6 Leadership
- 8.7 Linkage of research, extension and training
- 8.8 NARC, its establishment, objectives and activities
- 8.9 Role of Division and Research stations in fruit research and development in NARC.
- 8.10 Main constraints for agricultural research and development in Nepal

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), प्लाण्ट प्याथोलोजी उपसमूहको
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Plant Pathology

1. Introduction

- 1.1 Plant pathology and Plant diseases- Definition
- 1.2 Symptoms and classification of plant diseases
- 1.3 Importance and history of plant pathology
- 1.4 Effects of plant diseases on host growth and reproduction
- 1.5 Factors affecting disease developments
- 1.6 Epidemiology
- 1.7 Disease cycles
- 1.8 Plant pathological terminologies

2. Mycology

- 2.1 General characteristics of plant pathogenic fungi
- 2.2 Taxonomy and classification of fungi
- 2.3 Growth, reproduction, dispersal and survival (over-summering/ over-wintering) of fungi
- 2.4 Infection process and mechanisms of fungal diseases
- 2.5 Life cycle of some fungal diseases like –late blight of potato, club root disease of crucifers, Powdery mildew of cereals and vegetables, loose smut of wheat, black/stem rust of wheat, *Fusarium* wilt of tomato.

3. Bacteriology

- 3.1 General characteristics of plant pathogenic bacteria
- 3.2 Classification of plant pathogenic bacteria
- 3.3 Growth, reproduction, infection process, survival and spread
- 3.4 Predisposing factors of disease causing bacteria
- 3.5 General symptoms and identification of diseases caused by bacteria
- 3.6 Life cycles of some representative bacterial diseases such as - fire blight of apple, soft rot of vegetable, common scab of potato, black rot of cabbage, bacterial wilt of tomato, crown gall of apple and citrus canker

4. Nematology

- 4.1 General characteristics of plant pathogenic nematodes
- 4.2 Morphology and anatomy of the plant pathogenic nematodes
- 4.3 Growth, nutrition and reproduction
- 4.4 Isolation and extraction techniques

- 4.5 Identification, life cycles and management of the following nematode and the diseases; Root-knot of vegetable crops, soybean and potato cyst nematode, white tip of rice, ear cockle of wheat.

5. Virology

- 5.1 Introduction and characteristics of virus and virus like organisms
5.2 Classification and grouping of plant viruses
5.3 Structure, morphology and chemical compositions of plant viruses
5.4 Multiplication and transmission of plant viruses
5.5 Identification of plant viruses and virus like diseases- Tobacco mosaic virus, cucumber mosaic virus, Potato virus Y, Bean yellow mosaic virus, Rice tungro virus, barley yellow dwarf virus, Tomato leaf curl virus, Maize streak virus and Cauliflower mosaic virus.

6. Diseases and Characteristics of Diseases caused by Parasitic Plants

- 6.1 *Striga*
6.2 *Cuscuta*
6.3 *Orobancha*

7. Diseases Caused by Non-pathogenic Factors (Disorders)

- 7.1 Disorder caused by lack of major and micro nutrient
7.2 Disorders caused by environmental factors like temperature, oxygen, light, ozone, sulphur dioxide etc.
7.3 Symptoms and management of Khaira disease of rice, boron deficiency of cauliflower, black tip of mango, black head of potato, sunscald of pepper.

8. Plant Disease Diagnosis-Diagnosis technique and methods- Koch's postulate and other methods

9. Principle of Plant Disease Management

- 9.1 Exclusion, avoidance, protection, eradication and immunization.

10. Methods of Plant Disease Control

- 10.1 Regulatory methods, Physical methods, Cultural methods,
10.2 Host resistance (types of resistance, nature of resistance, tolerance)
10.3 Biological methods
10.4 Chemical methods - (types/groups of pesticides, major pesticides and their formulations, methods of evaluation, modes of action, methods of application, factors affecting pesticide performance, toxicity, pesticide resistance, seed treatment, sprayers and spraying techniques, fumigation, injection, safe storage and handling, precautions and antidotes).
10.5 Integrated disease management.

11. Distribution, losses, symptoms, causal organisms, predisposing factors and management of the following diseases of major crop plants in Nepal:

- 11.1 Rice- Blast, Bacterial Leaf Blight (BLB), sheath blight, brown leaf spot, false smut, foot rot, Khaira disease.
- 11.2 Wheat- Leaf rust, yellow rust, foliar blight, loose smut, Karnal bunt, powdery mildew.
- 11.3 Maize- Grey leaf spot, Northern leaf blight, Southern leaf blight, banded leaf and sheath blight, ear rot, cob rot, stalk rot, downy mildew and common smut.
- 11.4 Vegetables- Bacterial wilt of potato and tomato, late and early blight of potato and tomato, wart of potato, brown rot of potato, root-knot nematode of solanaceous crops, leaf curl of tomato and pepper, Phytophthora blight of pepper, club root of crucifer, white rust of crucifer, *Alternaria* leaf spots of broad leaf mustard, damping off of crucifers, downy mildew of cauliflower and cabbage, Turnip mosaic virus of broad leaf mustard, Phomopsis blight of brinjal, Cucumber Mosaic Virus in pepper and cucurbits, bacterial wilts of cucurbits, purple blotch of onion, downy mildew of onion, powdery mildew and rust of pea.
- 11.5 Legumes-
 - 11.5.1 Wilt, Stemphyllium blight and root rot of lentil
 - 11.5.2 Botrytis gray mold, root rot and wilt of chickpea
 - 11.5.3 Bean yellow mosaic, Anthracnose and rust of bean
 - 11.5.4 Wilt and sterility mosaic of pigeon pea
 - 11.5.5 Bacterial blight of bean, bacterial pustule and frog eye spot of soybean, mung-bean yellow mosaic virus
- 11.6 Fruits- Citrus greening, Citrus decline, Citrus canker, Apple scab, Papery bark of apple, Citrus gummosis, *Fusarium* wilt of banana, Mango malformation, Peach leaf curl and Guava wilt
- 11.7 Oiled crops- *Alternaria* leaf spot and Sclerotinia blight of mustard, Striga in tori, downy mildew of crucifers, white rust of crucifers and leaf spots of groundnut
- 11.8 Cash crops- Tobacco mosaic virus, charcoal rot of jute, yellow mosaic of jute, red rot of sugarcane, stem gall of coriander, orobanche in tobacco, angular leaf spot of cotton, wilt of cotton, rhizome rot of ginger, leaf spot of turmeric and coffee rust
- 11.9 Finger-millet- Blast, *Cercospora* leaf spot, sheath blight
- 11.10 Barley- Yellow rust, barley stripe, covered smut, powdery mildew

12. Seed Pathology

- 12.1 Seed borne diseases and their significance
- 12.2 Seed health testing of fungi, bacteria, nematodes and viruses.

13. Laboratory Technique

- 13.1 General knowledge of laboratory equipments- Microscopes, laminar flow, incubators, oven, autoclave, refrigerator and freezer, centrifuge, other machineries and glasswares
- 13.2 Different types of media and their preparation
- 13.3 Isolation, purification and maintenance of culture of different plant pathogens

13.4 Laboratory processes- Cleaning, sterilization, staining, preserving, fixing

13.5 Histopathological studies and other disease diagnosis techniques

14. Field Techniques: Field survey, collection of disease specimens, methods of disease recording, disease specimen preservation and cataloguing

15. Mushroom: Types of cultivated mushroom, cultivation techniques of *Agaricus* and *Pleurotus* mushroom species

16. Mycorrhiza: Mycorrhiza and their uses in plant pathology

17. Experimental Design and Statistical Analysis: Experimental designs, tests and hypotheses, mean separation, data transformation and data analyses by using common statistical packages, drawing conclusion and inferences based on analysis of the data

18. Scope of Bio-technology in Plant Pathology

18.1 Importance of tissue culture techniques in Plant Pathology

18.2 Use of molecular techniques in development of resistance varieties

18.3 Biotechnological tools for identification and characterization of plant pathogens

18.4 Other uses of biotechnology in plant pathology.

19. Cross-cutting Areas having Implications in Plant Pathology Development

19.1 General Knowledge of Nepal Agricultural Research Council

19.1.1 Its organizations, roles, objectives, importance and major activities

19.1.2 Its linkages within disciplinary divisions, commodity programs, R/ARS

19.1.3 Its linkages with agricultural institutions of federal government, provincial government, local government, IAAS and other national and International organizations

19.1.4 Scope and prospects of Agricultural research and NARC under federal system of Nepal

19.1.5 Agriculture Development Strategy (ADS), Recent Five Year Plan

19.1.6 Current Seed Act

19.2 Logical Framework Approach (LFA) of Project Formulation

19.2.1 Basic principle and importance of LFA

19.2.2 Process of LFA

19.2.3 Component of log frame matrix

19.3 Strength, Weakness, Opportunity and Threat (SWOT) analysis

19.4 Project Formulation and Report Writing- Project formulation based on NARC format and technical and scientific report writing.

19.5 Computer Knowledge: Basic knowledge applicable to plant pathology.

बरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), स्वायत्त साइन्स उपसमूहको
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject

Sub Faculty - Soil Science

1. Basic Soil Science

- 1.1 Rocks and minerals, their classification and sources of soil parent materials, Weathering and soil formation, Soil profiles and soil horizon
- 1.2 Soil-definition, soil structure, soil texture, bulk density, particle density, porosity, soil colour and soil aggregates
- 1.3 Soil moisture-classification, field capacity, wilting points, soil moisture measurement, Soil moisture retention curve, Infiltration and permeability.
- 1.4 Soil reaction- definition, numerical calculation of pH, its importance, lime and gypsum requirements,
- 1.5 Soil amelioration, lands reclamation
- 1.6 Soil organic matter- its role in crop production, humus and soil fertility)

2. Soil Fertility

- 2.1 Basic soil-plant relationship-Plant roots and soil relations, Soil fertility and productivity
- 2.2 Nutrient elements and their classification (primary, secondary and micronutrients)
- 2.3 Primary elements N, P and K and their function in plants, their deficiencies symptoms
- 2.4 Secondary elements and their importance
- 2.5 Soil fertility rating in Nepalese condition
- 2.6 Basic soil-plant relationships- ion exchange in soil (cations and anions), base saturation, effective CEC, exchangeable cations and their importance in soil fertility,
- 2.7 Soil organic matter management in soil fertility maintenance-stubble management, FYM, green manure, different types of green manure plants and their nutrient content in Nepal
- 2.8 Fertilisers-fertilisers containing nitrogen, phosphorus and potassium

3. Soil Conservation and Watershed Management

- 3.1 Soil degradation- physical, chemical and mechanical degradation, Land use and Land capability classification (arable land, grass land, pasture and forest including recreation), criteria for classification
- 3.2 Introduction to watershed management, The problem of watershed management in Nepal (imbalance due to anthropogenic pressure, restoring the balance, protect-preserve-improve)

- 3.3 Planning for watershed management-cropping system, farming system, improving farming practices, Restoration of soil fertility for sustainable production
- 3.4 Sloping agricultural land technology (SALT) - Importance in Nepalese condition, economics of slope cultivation, problem of slopping land cultivation in Nepal, soil and fertility losses, restoration of soil in slopes (hedge row cultivation, inclusion of fruit trees, leguminous trees in slopes and soil conservation used in Nepal)

4. Bio-fertilisers and Organic Farming

- 4.1 Organic Sources of plant nutrients, Role of organic matter in crop production, Soil organisms, Farm yard manure, Poultry manure, Compost Green manure, Vermicompost
- 4.2 Biological nitrogen fixation, Organisms associated with nitrogen fixation (Rhyzobium bacteria, Free living bacteria, Azospirillum, Blue green algae, Azolla, Other micro-organisms) Concept of organic farming, Integrated plant nutrient management system (IPNMS)
- 4.3 Losses- nitrification, denitrification, volatilisation, leaching, fixation

5. Soil Survey, and Soil Classification

- 5.1 Soils morphology and soil survey, methods used in soil survey
- 5.2 Soil classification and soils found in Nepal
- 5.3 Preparation of soil survey reports
- 5.4 Supplemental Procedures -collection and preparation of samples, general laboratory procedures, physical properties of soils, some chemical properties of soil, soil salinity alkalinity and its reclamation
- 5.5 Geographic Information System (GIS), remote sensing and soil mapping

6. Statistics

- 6.1 Frequency, mean, median, mode, standard deviation, standard error, normal distribution, smapling methods, methods of hypothesis testing
- 6.2 Design of field experiments
- 6.3 Analysis of variance
- 6.4 Regression and correlation (simple linear regression and correlation)

7. Others

- 7.1 Soil fertility problem of Nepal, Role of soil scientists in tackling soil problems
- 7.2 Soil productivity and crop production in Nepal. Measures to increase crop production from soil fertility points
- 7.3 Nepal Agriculture Research Council addressing soil fertility problems in Nepal

वरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), लाइभस्टक प्रडक्ट प्रोडक्शन एण्ड
म्यानेजमेण्ट उपसमूहको आन्तरीक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Faculty: Livestock Production and Management

1. Livestock Production and Management

- 1.1 Livestock Production system in Nepal
 - 1.1.1 Cattle, Yak and Chauri
 - 1.1.2 Buffaloes
 - 1.1.3 Sheep and goat
 - 1.1.4 Pig, poultry and rabbits
- 1.2 Design of housing and shed construction for different species of livestock and birds
- 1.3 Integration of crop, livestock, forestry, horticulture and fisheries for improving the efficiencies of agricultural production system in Nepal
- 1.4 Site selection and housing floor requirement for different stages farm animals
- 1.5 Different methods of animal identification and record keeping system in Livestock farm
- 1.6 Disposal of animal waste and their management
- 1.7 Castration, dehorning, grooming, dipping, shearing of sheep and rabbit and de-beaking of poultry
- 1.8 Care and management of sick animal, isolation, segregation, and quarantine
- 1.9 Incubation and hatching of eggs

2. Dairy Animal (Buffalo and Cattle) Keeping and their Management

- 2.1 Dairy record keeping
- 2.2 Breeding better dairy animal
- 2.3 Reproduction and lactation
- 2.4 Dairy herd management
- 2.5 Feeding dairy animal
- 2.6 Dairy research

3. Poultry Production and Management

- 3.1 Incubation and hatchery management
- 3.2 Brooding and Rearing
- 3.3 Poultry housing and equipment
- 3.4 Poultry feeding and management
- 3.5 Poultry breeding and management
- 3.6 Poultry Diseases and their preventive measures
- 3.7 Marketing of eggs and poultry
- 3.8 Poultry research

4. Goat Production and Management

- 4.1 Goat production and their important in Nepal
- 4.2 Goat breeding
- 4.3 Goat nutrition
- 4.4 Housing and management
- 4.5 Goat diseases and preventive measures
- 4.6 Goat research and marketing

5. Sheep Production and Management

- 5.1 Sheep production in Nepal
- 5.2 Breeds and breeding of sheep in Nepal
- 5.3 Sheep grazing system in Nepal
- 5.4 Shearing wool and wool production
- 5.5 Diseases and parasite of sheep and their preventive measures
- 5.6 Sheep and wool marketing

6. Pig Production and Management

- 6.1 Pig housing and waste management
- 6.2 Pig nutrition and feeding
- 6.3 Pig breeds and breeding in Nepal
- 6.4 Pig diseases and parasites and their preventive measures
- 6.5 Pig research and marketing

7. Pasture, Fodder and Fodder Tree Production

- 7.1 Pasture species suitable to different ecology ie mountain, hills and Tarai
- 7.2 Forage species for different seasons and suitable to hills, mountain and tarai
- 7.3 Fodder trees for Hills, Mountain and Tarai
- 7.4 Plant physiology, plant nutrient management
- 7.5 Plant introduction, evaluation and utilization
- 7.6 Conservation of forages, crop by-product and their utilization
- 7.7 Agronomic and other management practices of fodder trees and forage crop
- 7.8 Nursery management
- 7.9 Hay and silage making

8. Dairy Technology

- 8.1 Theory of milk secretion
- 8.2 Composition of milk of farm animals
- 8.3 Factors affecting the milk composition of milk and its quality
- 8.4 Pasteurization and homogenization of milk, packing and distribution of milk
- 8.5 Sanitization of dairy plant utensils and equipments
- 8.6 Testing of fluids quality

8.7 Diversified dairy products, ice cream, cheese, and dairy based sweets production

9. Statistics

9.1 Simple Experimental Design and data analysis

9.2 Statistical data analysis

9.3 Correlation and Regression

9.4 Analysis of Variance

9.5 Experimental design on farm animals and avian with data analysis packages

10. Others

10.1 Production and productivity of different breeds of livestock, swine and avian in Nepalese condition.

10.2 Status of per-capita consumption and production of livestock and poultry products in Nepalese diet.

10.3 Role of Livestock Scientist for improving the socio-economic status of rural Nepalese people.

10.4 Structure, objectives and activities of NARC council and NARC executive Board

*

**

वरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), पाश्चर / फोरेज एण्ड एग्रो फरेष्ट्री
उप-समूहको आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Pasture, Forage and Agro-forestry

1. Forage Physiology

- 1.1 Photosynthesis and respiration.
- 1.2 Seed development, seed dormancy, germination and other physiological processes associated with seed production and storage of economically important pasture/ forage and fodder tree seeds

2. Forage Breeding

- 2.1 Principles of breeding
- 2.2 Breeding and improvement objectives
- 2.3 Breeding methods for self pollinated and cross pollinated crops
- 2.4 Forage and pasture crop evolution.

3. Forage Agronomy

- 3.1 Plant introduction, evaluation and utilization
- 3.2 Fertilization and liming
- 3.3 Cutting management
- 3.4 Irrigation management
- 3.5 Factors affecting crop adaptation, production, utilization and conservation.
- 3.6 Cropping systems, crop rotation, inter-cropping, mixed cropping, multiple cropping and mixed farming systems
- 3.7 Marginal land utilization for pasture, forage and fodder trees

4. Production Technology

- 4.1 Production technology of forage crops
- 4.2 Production technology of temperate species in rangelands and pasturelands
- 4.3 Production technology of fodder trees

5. Grazing and Range Management

- 5.1 Grazing practices
- 5.2 Stocking rate and grazing pressure
- 5.3 Fodder and feed from trees and shrubs, grassland productivity and carrying capacity, productivity influencing factors

6. Herbage Quality and Nutritive Value

- 6.1 Nutritive value, digestibility and forage intake
- 6.2 Feeding value of grass, legume and its products
- 6.3 Forage quality i.e. cell wall contents, cell contents, digestibility, total digestible nutrients and metabolizable energy

- 7. Agro-forestry**
 - 7.1 Scope and advantage
 - 7.2 Classification of agro-forestry systems
 - 7.3 Management of trees in agroforestry systems
 - 7.4 Economics of agroforestry systems
- 8. Forage Conservation**
 - 8.1 Principles of conservation
 - 8.2 Silage making
 - 8.3 Hay making
- 9. Forage Toxicology**
 - 9.1 Antiquality constraints and disorders
- 10. Forage Diseases and their Control**
 - 10.1 Diseases of pasture/forage and fodder trees, seed borne, soil borne and air borne diseases
 - 10.2 Biological control and cultural control measures of pasture/forage and fodder tree pathogens
- 11. Forage Insects Management and their Control**
 - 11.1 Principles of insect- pest control, physical and mechanical control, cultural control, biological control, chemical control and host plant resistance
 - 11.2 Toxicity of insecticides, precaution in the use of insecticides, insecticide-application equipment
- 12. Statistics**
 - 12.1 Experimental designs and data analysis (parametric and non- parametric)
- 13. Others**
 - 13.1 Livestock population and their distribution in Nepal
 - 13.2 Production and productivity of livestock in Nepal
 - 13.3 Ruminant's digestive, productive and reproductive systems
 - 13.4 Classification of feeds
 - 13.5 Proximate analysis of feeds
 - 13.6 Types of grassland and its distribution
 - 13.7 General knowledge about NARC

---****---

वरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), एनिमल न्यूट्रिशन एण्ड फीडिङ
उपसमूहको आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject

Sub-Group: Animal Nutrition and Feeding

1. Introduction

- 1.1 Nutrition and its importance in livestock and avian production system in Nepal
- 1.2 Gastrointestinal tract and nutrition
- 1.3 Anatomy and function of the gastrointestinal tract, the role of digestive enzymes. Rumen metabolism, rumen fermentation, blood and nutrition Fecal and urinary excretion
- 1.4 Measurement of feed and nutrient utilization
- 1.5 Nutrient requirements of animals
- 1.6 Growth trials, digestion trials; conventional methods, indicator method, digestibility by difference, associative effects. Apparent vs. true digestibility, balance trials and purified diets. Estimation of nutrients requirements of animals, sequence of events in nutrient deficiency and establishing specific nutrient requirements

2. Nutrient Metabolism

- 2.1 Water - functions, absorption, sources of water, water losses, water requirements and water quality in relation to animal nutrition
- 2.2 Protein-functions, metabolism, absorption, amino acid synthesis, requirements, deficiency symptoms, use of non-protein nitrogen in ruminant animals, amino acid antagonism and toxicity and measures of nutritive value of protein
- 2.3 Lipids - Structure, functions, absorption, metabolism, deficiency symptoms of lipid in farm animals
- 2.4 Carbohydrate-Classification, structure, functions, metabolism, absorption, abnormal carbohydrate metabolism and utilization of plant fiber in farm animals
- 2.5 Sources, functions, deficiency symptoms and toxicity of minerals and vitamins in farm animals

3. Feeding Standard and Productive Functions

- 3.1 Terminology used in feeding standard
- 3.2 Maintenance requirements
- 3.3 Nutrients requirement for growth and fattening
- 3.4 Nutrients requirements for working animals
- 3.5 Nutrients requirements for reproduction
- 3.6 Nutrients requirements for lactating animals

4. Feed Stuffs for Animals

- 4.1 Classification of feed stuffs- roughages, hay, silages, concentrates (energy sources) and protein concentrates, mineral supplements, vitamin supplements and non – nutritive feed additives
- 4.2 Pasture and forages
- 4.3 Hay, hay making process and crop suitable for hay making

- 4.4 Silage, silage making process and crops suitable for silage making
- 4.5 High energy content feed stuffs – cereal grain, milling by products, liquid energy sources, other high-carbohydrate feed stuffs, fats and oils
- 4.6 Protein concentrates – protein supplement of animal origin, plant protein concentrates and non-protein nitrogen compounds
- 4.7 Minerals and vitamin supplements
- 5. Animal Feed Preparation and Processing**
 - 5.1 Grain processing – dry and wet processing
 - 5.2 Roughage processing for ruminants
 - 5.3 Feed formulation for different livestock species
 - 5.4 Information needed for feed formulation
 - 5.5 Mechanics of diet formulation – Pearson's square, simultaneous equations
 - 5.6 Mathematical programming – least cost vs. maximum profit formulation, formulating premixes and supplements
- 6. Laboratory Procedure in Animal Nutrition**
 - 6.1 Layout of analytical laboratory
 - 6.2 Chemicals, reagents, glassware, equipment, appliances and animal shed facilities needed for animal nutrition research
 - 6.3 Preparation of chemicals and reagents, solution, equivalent weight, normality, molality, preparation of indicators, storing and preservation of standard solutions. Cleaning and drying of glassware and general precaution needed in animal nutrition laboratory
 - 6.4 Sampling collection and processing of feeds and biological materials for analysis
 - 6.4.1 Sampling of dry roughages, green forages, silage, hay, concentrate, residue (left over after feeding), faeces, urine and milk
 - 6.4.2 Processing and preservation of dried samples, wet samples, urine and milk for laboratory analysis
- 7. Statistical Procedures for Animal Nutrition Research**
 - 7.1 Completely randomized design (CRD)
 - 7.2 Randomized Completely block design (RCBD)
 - 7.3 Latin square design
 - 7.4 Analysis of variances
 - 7.5 Analysis of covariance
 - 7.6 Regression and correlation analysis
 - 7.7 Frequency distribution
- 8. Others**
 - 8.1 Nepal Agricultural Research Council; establishment, objective, role and activities
 - 8.2 Main constraints, issues, production situation of livestock products in relation to animal nutrition research in Nepal

वरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), फिसरीज उप-समूहको आन्तरिक
प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Fishery

1. Fish Biology:

- 1.1. General biology of cultivable fishes
 - 1.1.1. External and internal features of fish
 - 1.1.2. Integumentary system: Skin, scale and fin
 - 1.1.3. Digestive system: alimentary canal and associated glands
 - 1.1.4. Respiratory system: Gill, and accessory respiratory organs
 - 1.1.5. Excretory system: kidney, Excretion and osmo-regulation
 - 1.1.6. Reproductive system: Male and female reproductive organs, Seasonal cycles, gametogenesis, Endocrine glands in fishes
- 1.2. Main characteristics of fishes and Shellfish
 - 1.2.1. Indian Major carps (rohu, mrigal and bhakur)
 - 1.2.2. Silver barb
 - 1.2.3. Common carp
 - 1.2.4. Chinese carps (grass carp, silver carp and bighead carp)
 - 1.2.5. Pangas
 - 1.2.6. Tilapia
 - 1.2.7. Asala
 - 1.2.8. Sahar
 - 1.2.9. Rainbow trout
 - 1.2.10. Fresh water Prawn

2. Fish Culture:

- 2.1. Aquaculture System
 - 2.1.1. Monoculture
 - 2.1.2. Polyculture
 - 2.1.3. Monosex culture
- 2.2. Aquaculture Techniques
 - 2.2.1. Extensive
 - 2.2.2. Semi-intensive
 - 2.2.3. Intensive
 - 2.2.4. Super-Intensive
- 2.3. Aquaculture Practices
 - 2.3.1. Pond culture
 - 2.3.2. Raceway culture

- 2.3.3. Cage fish culture
- 2.3.4. Enclosure fish culture
- 2.3.5. Integrated fish Farming
 - 2.3.5.1. Poultry birds (chicken and ducks)-fish system
 - 2.3.5.2. Horticulture (vegetables and fruits)-fish system
 - 2.3.5.3. Grass-fish system
 - 2.3.5.4. Livestock-fish system
 - 2.3.5.5. Rice-fish culture
 - 2.3.5.6. Fish-fish culture (Carp-SIS)
 - 2.3.5.7. Aquaponics
 - 2.3.5.8. Managing sub-systems in an integrated farming
 - 2.3.5.9. Interlinking an integrated fish farming system and nutrient recycling
- 2.3.6. Bio-floc based fish farming
- 2.3.7. Economics of fish culture- production cost, fixed costs, variable costs, returns

3. Pond Construction and Management:

- 3.1. Principles of site selection for pond fish construction
- 3.2. Design and pond construction
- 3.3. Types of pond- design and construction, nursing and rearing pond, production pond, and brood fishpond
- 3.4. Pond management- Drying, liming, fertilization (inorganic and organic fertilizer), water management, fish species and stocking, feeding and harvesting

4. Fish Breeding:

- 4.1. Brood fish management
- 4.2. Selection of broods for breeding
- 4.3. Natural breeding, Semi artificial breeding and artificial/induced breeding of cultivable fishes
- 4.4. Types of hormones- Pituitary gland, Human Chorionic Gonadotropins (HCG), Leutinizing releasing hormone analogue (LRH-A), Ovaprim
- 4.5. Hormones use techniques and dose calculations
- 4.6. Genetic improvement of fish: selective breeding and mating design of breeding plan
- 4.7. Ways of fish genetic resources loss; inbreeding and its consequences

5. Hatchery Management:

- 5.1. Importance of quality seeds
- 5.2. Operation of hatcheries- spawning, fertilization, incubation, and hatching for warm water and coldwater fishes
- 5.3. Larvae nursing Technique
- 5.4. Indoor fry nursery technique
- 5.5. Fry transportation

6. Water Quality and Plankton:

- 6.1. Importance of water quality in aquaculture
- 6.2. Physical parameters
 - 6.2.1. Temperature, Thermal stratification and de-stratification, Water color, Transparency, Turbidity, Solids
- 6.3. Chemical parameters
 - 6.3.1. Dissolved Oxygen, pH, Alkalinity, Hardness
 - 6.3.2. Nutrients (Different forms of N and P)
- 6.4. Biological parameters
 - 6.4.1. Planktons, Primary productivity, Chlorophyll-a, Benthos, Detritus
 - 6.4.2. Bottom soil
 - 6.4.2.1. Soil texture
 - 6.4.2.2. Lime requirement
 - 6.4.2.3. Relationship of pond bottom soil and water quality and its effect
- 6.5. Water sampling Techniques and analysis
 - 6.5.1. Analytical methods of Physical parameters
 - 6.5.2. Analytical methods of Chemical parameters
 - 6.5.3. Analytical methods of Biological parameters
 - 6.5.4. Analytical methods of Bottom soil
- 6.6. Aquaculture intensification, pond bottom management and water quality inter-relationships

7. Fish Nutrition:

- 7.1. Nutritional requirements of cultivable fish and shellfish
- 7.2. Feed formulation and its proximate evaluation
- 7.3. Essential and non-essential aminoacids
- 7.4. Vitamins and Essential minerals
- 7.5. Feed additives
- 7.6. Non- conventional feed ingredients
- 7.7. Anti-nutritional factors
- 7.8. Nutritional deficiency sign and symptoms

8. Live Food Production

- 8.1. Nutritional value of live food
- 8.2. Candidate species of phytoplankton and zoo-plankton as live food organisms of freshwater species
- 8.3. Biology and culture requirements of important live food organisms

9. Fish Disease:

- 9.1. General symptom of infectious disease and its causes
- 9.2. Relationships of the Host, Pathogen, and Environment: Implications

- 9.3. Types of general fish diseases (Bacterial, Fungal and Protozoan) and its management measures
- 9.4. Non-infectious diseases
- 9.5. Fish predators and their control measures
- 9.6. Common drugs, chemicals and their application
- 9.7. Good Aquaculture Practices
- 10. Fish Kills:**
 - 10.1. Overabundant Aquatic Vegetation/ Planktonic algae, Asphyxia, and preventive measure
 - 10.2. Issues of improper Aquatic herbicides use, poisoning
 - 10.3. Pond turnover and management
- 11. Aquatic Weeds:** Types of common aquatic weeds, control methods
- 12. Ornamental Fishes:**
 - 12.1. Aquarium construction and fabrication of ornamental fish rearing facilities.
 - 12.2. Important ornamental fishes, ornamental aquatic plants and its value addition
 - 12.3. Breeding, disease and feeding management of Aquarium fish
 - 12.4. Varieties egg layers and live bearers of Aquarium fish
- 13. Post Harvest Technology:**
 - 13.1. Fish processing and preservation methods
 - 13.2. Fish packing methods and value addition
 - 13.3. Fisheries byproducts
- 14. Biostatistics:**
 - 14.1. Measures of central tendency- Mean, Median, Mode
 - 14.2. Measures of dispersion- quartile deviation, range, variance, mean and standard variation.
 - 14.3. Probability: normal distribution, standard sampling error and test of hypothesis, estimate of error
 - 14.4. T-test, F-Test and Chi-square test
 - 14.5. Regression and correlation: simple linear regression and correction
- 15. NARC: Main objectives of NARC, present status and role of Fisheries Research Centers and units under NARC**

---****---

वरिष्ठ प्राविधिक अधिकृत, टि-७ (Senior Technical Officer, T-7), भेटरिनरी उप-समूहको
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

Technical Subject
Sub-Group: Veterinary

A. Basic

1. Anatomy and Histology

- 1.1. Classification of bones, gross structure of different bones and cartilages, functional osteology
- 1.2. Arthrology – structural and functional anatomy of joints
- 1.3. Myology – structure and functions of various muscles
- 1.4. Anatomy of central and peripheral nervous system, autonomic nervous system and meninges
- 1.5. Gross structure of circulatory organs – heart, aorta and venacava, arteries, veins, spleen, lymph nodes
- 1.6. Gross structure of visceral organs – organs of digestive, respiratory, reproductive, urinary and endocrine systems
- 1.7. Anatomy of special sense organs
- 1.8. Histology: cell structure and organelles, histological techniques
- 1.9. Microscopic structure of the organs of digestive, respiratory, urinary, reproductive, nervous, cardiovascular, sense organs, endocrine glands, lymphoid organs, bone marrow and blood

2. Embryology

General embryology, embryonic and fetal development of the organs of digestive, respiratory, urogenital, cardiovascular, nervous and locomotary organs. Description of embryo developmental stages in chick model

3. Animal Physiology

- 3.1. Introduction to physiological chemistry, enzymes and coenzymes and their classification, metabolism of carbohydrates, proteins, fat, nucleic acid, DNA synthesis, metabolism of macro and micro minerals, vitamins and their functions
- 3.2. Biochemistry of carbohydrates, proteins, lipids, vitamins, nucleic acid; structure of DNA and RNA. Synthesis of proteins and other biomolecules
- 3.3. Biochemistry of blood, plasma, hemoglobin, lymph, soft tissues and bones. Blood coagulation process
- 3.4. Biochemistry of respiration, acid base balance, renal function, stress and shock. Liver function and detoxification
- 3.5. Biochemistry of hormones

- 3.6. Physiology of locomotor system – muscle contraction and its mechanism. Electrical changes in skeletal and cardiac muscle, rhythmic excitation, heart beat, electrocardiogram
 - 3.7. Physiology of circulation: cardiac cycle and hemo-dynamics, neural and chemical control of blood vessels, blood pressure, cardiac output, its variation and regulation, fluid and electrolyte balance, functions of blood
 - 3.8. Mechanism and chemistry of respiration, exchanges of gases in lungs and tissues, law of solubility of gases, regulation of respiration, respiratory reflexes, hypoxia, role of respiration in acid base balance, respiration in birds
 - 3.9. Physiology of digestion, absorption and excretion in ruminants, mono-gastric animals and birds
 - 3.10. Nervous system: function of neurons and nerve fibers, synapse, transmission of nerve impulse, cutaneous receptor organs, spinal cord and reflex actions, function of brain stem and cerebellum, cerebral hemispheres. Conditioned reflexes, autonomic nervous functions: general arrangement and chemical transmission
 - 3.11. Functions of sense organs, Physiological mechanism for vision, hearing, olfaction, touch and taste
 - 3.12. Reproduction and endocrine functions: reproductive organs and their functions in male and female animals. Mammary gland function and mechanism of lactation in females
 - 3.13. Physiology of growth. Environmental and climatic physiology of domestic animals. Acclimatization and adaptation
 - 3.14. Recent advances in physiological effects of production functions in high yielding animals
- 4. Molecular Biology and Biotechnology**
- 4.1. History of molecular biology, basic principle of biosynthesis, genome, gene sequencing, polymerase chain reaction
 - 4.2. Biotechnology: basic principles, tools applicable in veterinary science – Reproduction, embryo transfer technology, in vitro fertilization, pregnancy diagnosis, transgenic animals, disease diagnosis, hybridoma, monoclonal antibody production, DNA probes, Fermentation, vaccine production, cell culture and microscopic manipulation

B. Applied Para-clinical

1. Veterinary Pharmacology and Toxicology

- 1.1. Introduction to pharmacology, history, scope and its development
- 1.2. Pharmacodynamics, drugs metabolism, action and excretion
- 1.3. Drugs acting on autonomic nervous system-adrenergic antagonists, adrenoceptors blockers, adrenergic neuron blockers, cholinergic antagonist and blockers, ganglionic stimulants and blockers, Pharmacology of anesthetic agents – local and general
- 1.4. Transmitters of CNS, analeptics and other CNS stimulants
- 1.5. Principles of chemotherapy; sulfonamides

- 1.6. Antibiotics and antibacterial agents–history, development, chemistry, action and resistance; antifungal agents
- 1.7. Principles of drug activity: pharmacokinetics –absorption, distribution, biotransformation and excretion of drugs, pharmacodynamics- concept of drug and receptors, dose-response relationship, terms related to drug activity and factors modifying the drug effect and dosage
- 1.8. History and theories of general anaesthesia; volatile, gaseous, intravenous and dissociative anaesthetics, hypnotics and sedatives, tranquilizers, analgesics
- 1.9. Antipyretics, analgesics, and anti inflammatory agents
- 1.10. Peripheral and central muscle relaxants
- 1.11. Histamine and antihistaminic agents; prostaglandins, angiotensin and bradykinin
- 1.12. Drugs acting on circulatory system: chemistry, action and therapeutic uses
- 1.13. Drugs acting on digestive tract
- 1.14. Drugs acting on respiratory system
- 1.15. Drugs acting on endocrine system- adrenocorticosteroid, sex hormones, insulin and other hypoglycemic agents, thyroid hormones
- 1.16. Drugs acting on skin and mucus membranes
- 1.17. Anthelmintics, antiprotozoal, antiviral, antifungal, antituberculus and anticancer agents
- 1.18. Antiseptics and disinfectants
- 1.19. Hormones –hormone stimulating and inhibiting drugs, antagonists, hypoglycaemic agents, prostaglandins, oxytocin, anabolics, growth promoters and corticosteroids
- 1.20. Commonly used herbal drugs in veterinary medicine
- 1.21. General toxicology: scope, source of poisoning, mode of action of poisons, factors modifying toxicity and line of treatment of poisoned cases
- 1.22. Toxicity caused by metals and non metals-arsenic, lead, mercury, copper, zinc selenium, phosphorus, nitrates, nitrite, carbamates common salt and fluosis
- 1.23. Plant toxicity due to various poisonous plants
- 1.24. Toxicity caused by commonly used drugs, mycotoxins, bacterial toxins and others
- 1.25. Toxicity caused by agrochemicals, insecticides, herbicides and rodenticides
- 1.26. Venoms, bites and stings
- 1.27. Environmental toxicity- toxicity caused by air, water, food additives and preservatives
- 1.28. Current research trends and advances in drug development

2. Veterinary Parasitology

- 2.1. History and development of veterinary parasitology,
- 2.2. Parasites of veterinary importance and their classification
- 2.3. Parasites, parasitism, commensalism and symbiosis
- 2.4. Host-parasite relationship and specificity between parasites and hosts and development of parasites in the host system.
- 2.5. Natural and acquired immunity, parasitic immunity
- 2.6. Anthelmintics Drugs
- 2.7. Parasitological techniques

- 2.8. Etiology, lifecycle, transmission, epidemiology, pathogenesis, symptoms, diagnosis, treatment, prevention and control, and economic significance of the following diseases of cattle, buffalo, sheep, goat, pigs, poultry, pet animals and wild life species with regard to:
 - 2.8.1. Nematodal diseases
 - 2.8.2. Liver fluke
 - 2.8.3. Other tape worm infections and infestations
 - 2.8.4. Protozoal diseases
 - 2.8.5. Diseases due to arthropods
 - 2.8.6. Parasitic diseases (both protozoal and helminthic) of zoonotic significance
- 2.9. Arthropods as vectors of various infectious diseases
- 2.10. The epidemiology of parasitic diseases and recent approaches for the control of
- 2.11. Parasitic diseases.
- 2.12. Immunity to parasitic diseases, vaccines and vaccination against parasitic diseases
- 2.13. Recent advances in the study of veterinary parasitic diseases in Nepal and abroad.

3. Veterinary Microbiology and Immunology

- 3.1. Introduction to bacteriology, history, scope and development. Physiology of microorganisms including metabolism. Classification and characteristics of pathogenic bacteria. Bacteriological techniques and methods
- 3.2. Introduction to mycology
- 3.3. The classification of animal viruses: DNA and RNA viruses; unclassified viruses
- 3.4. Etiology, transmission, symptoms, pathogenesis, diagnosis, laboratory investigation, treatment, prevention, control and economic importance of
 - 3.4.1. Bacterial diseases of cattle, buffalo, pigs, goats, sheep, pet animals and wildlife species
 - 3.4.2. Fungal diseases of domestic animals and birds
 - 3.4.3. Viral diseases of cattle, buffalo, pigs, goats, sheep, pet animals and wildlife species
 - 3.4.4. Diseases associated with bacterial toxins and antitoxins
 - 3.4.5. Diseases associated with fungal toxins
 - 3.4.6. Rickettsial diseases
 - 3.4.7. Bacterial, viral and fungal diseases of zoonotic significance
- 3.5. Methods used in virological studies
- 3.6. Isolation, characterization, banking of causative agent and referral diagnosis of diseases of microbial origin
- 3.7. Mastitis: economic significance, causes, symptoms, pathogenesis, treatment, prevention and control
- 3.8. General characteristics of viruses and viral diseases, bacteriophage
- 3.9. Cultivation of viruses in developing chicken embryos, primary cell cultures and cell lines and animals
- 3.10. Introduction to immunology: inflammation as an immune response

- 3.11. Immunochemistry: antigens and antigenic determinants, structure and types of antibodies, immuno-modulation – principles and practices
- 3.12. Immunodiagnostic tests used in veterinary diagnostics
- 3.13. Cellular and humoral immunity and mechanisms involved in it.
- 3.14. Organs of the immune system, ontogeny, immune response – humoral and cell mediated immune response, vaccine and vaccination, the detection and measurement of antigen and antibodies. Resistance to bacteria, viruses, parasites, tumors. Hypersensitivity, autoimmunity, drugs and agents that affect (potentiate and suppress) the immune response, Immune-deficient diseases of livestock and poultry
- 3.15. Recent developments in veterinary microbiology and immunology, genetic intervention for disease resistance

4. Veterinary Pathology

- 4.1. Introduction to veterinary pathology, History, scope and development
- 4.2. Methods and techniques in pathological studies, Post-mortem examination technique and disease specific lesions and findings, histo-pathological studies and disease specific microscopic lesions, hematology
- 4.3. Sample collection, processing, preservation, transport and dispatch
- 4.4. General and systemic pathology with reference to infectious and noninfectious diseases of domestic animals and poultry
- 4.5. Pathology of the diseases caused by nutritional deficiency and metabolic diseases in livestock, pets and poultry
- 4.6. Introduction to general pathology, special pathology and systemic pathology
- 4.7. Oncology: tumors, cancers, classification, cause and pathology of different types of tumour, difference between benign and malignant tumour
- 4.8. Present trends in disease diagnosis, molecular probes

5. Veterinary Epidemiology

- 5.1 Introduction epidemiology. Host, disease factor and environment; Ecological concept of disease. Disease surveillance.
- 5.2 Type of epidemiological studies - case control, cohort studies, retrospective, cross sectional and perspective studies, disease forecasting.
- 5.3 Disease process and its spread, pattern of disease distribution in the community,
- 5.4 Investigation of disease epidemics
- 5.5 Laws regulating animal diseases in Nepal and international laws related to disease regulations: handling, import and export of biologicals, animal products and the animals
- 5.6 OIE categorizations of communicable diseases
- 5.7 Computer in data analysis
- 5.8 Current advances in veterinary epidemiology

C. Applied Subjects on Veterinary Clinical Research, Veterinary Ethics and Jurisprudence

- 1 Legal duties of veterinarians, forensic and state medicine, laws, common offences against animals and laws related to those offences, legal points and examination of live and dead animals in criminal cases, mischief, killing, maiming and poisoning, cruelty to animals and bestiality
- 2 History of Veterinary Science in Nepal
- 3 Current laws in veterinary practices:
- 4 Animal Health and Livestock Services Act, 2055 & regulation
- 5 Slaughter house and meat inspection Act, 2055 & regulation
- 6 Nepal Veterinary Council Act, 2055 & regulation
- 7 Feed Act 2033 & regulation
- 8 Veterinary ethics and code of conduct, common offences against animals, forensic veterinary investigation and practice, public health laws.
- 9 National and international regulation on import and export of livestock, livestock products and biologicals
- 10 Adulteration in livestock products, their detection and legal action

D. Veterinary Medicine (Preventive and Therapeutic)

1. History and scope of medicine, concept of animal disease, health and disease concept, etiological agents, infection and immunity
2. Clinical examination and diagnosis of diseases in the sick animals
3. General and systemic states, hyperthermia, hypothermia, fever, toxemia, septicemia, shock and dehydration
4. Definition, etiology, clinical symptoms, pathogenesis, clinical pathology, diagnosis, treatment, prevention and control of the diseases of digestive, respiratory, cardiovascular and lymphatic, uro-genital, nervous, sense organs, skin, musculo-skeletal systems of cattle, buffaloes, horses, pigs, sheep, goats and pet animals
5. Diseases of new born animals
6. Definition, etiology, clinical symptoms, pathogenesis, clinical biochemistry, clinical pathology, diagnosis, treatment, prevention and control of metabolic diseases (like: milk fever, ketosis, lactation tetany, downer cow syndrome, hypomagnesaemia) and nutritional deficiency diseases in domestic animals, pets and poultry
7. Incidence, etiology, epidemiology, transmission, clinical symptoms, pathogenesis, clinical biochemistry, clinical pathology, diagnosis, treatment, prevention and control of diseases caused by bacteria, viruses, chlamydia, rickettsia, protozoa, parasites and fungi in domestic animals, pets and poultry
8. Definition, etiology, clinical symptoms, pathogenesis, clinical biochemistry, clinical pathology, diagnosis, treatment, prevention and control of diseases caused by physical and chemical agents
9. Diseases caused by allergy
10. Diseases caused by undesirable inherited characters and unknown etiologies

11. Health management and health record keeping in a herd/flock
12. Recent advances in research in veterinary medicine and new technologies in diagnosis, treatment and control of major diseases
13. Emerging diseases of livestock and poultry

E. Reproduction and Reproductive Diseases

1. Male and female reproductive system, organs and their development. Reproductive cycle of cattle, buffalo, sheep, goat, pig, poultry, pet animals and wild life species
2. Hormones of reproduction and their functions, application for reproductive management
3. Infectious and non-infectious reproductive diseases of male and female animals: etiology, pathogenesis, symptoms, treatment, prevention and control. Eutocia and dystocia in females
4. Role of nutrition in reproduction, deficiency related reproductive problems
5. Introduction to assisted reproductive technologies: artificial insemination and embryo transfer, semen collection, evaluation, processing and preservation, sperm pathology and associated diseases
6. Diseases transferable through semen and embryo
7. Major reproductive disorders in cattle, buffalo, sheep, goat, pigs and poultry in Nepal
8. Current research focus in reproduction and reproductive diseases in Nepal and abroad

F. Surgery and Radiology

1. History and development of veterinary surgery, general surgical principles
2. Pre-operative and post-operative considerations, asepsis and antisepsis
3. Introduction to anesthesiology. Various anesthetics, their properties and applications
4. Introduction to Radiology, its application in disease diagnosis and operations
5. Introduction to ultrasound imaging, importance, principles and application in veterinary practice
6. Major and minor operations: hemostasis, operation procedures, complications and their prevention
7. Surgical infections, their prevention and management
8. Fractures: types, complications and treatment. Healing of bones.
9. Regional clinical surgery in relation to various conditions demanding surgical intervention

G. Public Health and Meat Hygiene

1. Organization, layout and management of slaughterhouses
2. Pre-slaughter care of animals, handling and transport of meat animals, ante-mortem examination
3. Techniques of humane slaughtering
4. Different techniques of slaughtering, evisceration and dressing
5. Chilling, ageing and evaluation of dressed carcasses and carcase yield
6. Utilization of slaughterhouse by products
7. Disposal of condemned parts and animals suffering from notifiable diseases

8. Examination of carcasses of different livestock species for meat borne diseases
9. Development of meat industry-structure, composition, nutritive value, post mortem changes and eating quality of meat tissues
10. Principles of various preservation techniques
11. Standard and quality control measures adopted for meat and meat products
12. Fraudulent substitution of meat and its recognition
13. Chemical composition and nutritive value of meat obtained from farm livestock and poultry
14. Zoonotic diseases and their diagnosis, treatment and control
15. Role of veterinarian for the control of zoonotic diseases
16. Drug residue in animal food and Antimicrobial Resistance

H. Research Methodology and Statistics

1. Introduction to statistics
2. Probability, frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling theory, test of hypothesis, confidence intervals
3. Students t test, Chi-square test, F test
4. Estimate of error- replication and randomization
5. Randomized complete block design-layout, randomization, analysis of variance
6. Two factorial experiment- randomization, layout and analysis of variance, interaction
7. Comparison - pair comparison by least significant difference, group comparison-between groups, comparison within group, ANOVA
8. Regression and correlation - simple linear and non linear, multiple linear and non linear; correlation
9. Importance and use of statistics in bio-sciences research
10. Introduction to sociology and veterinary extension

I. Laboratory Techniques for Disease Investigation

1. Specimens for disease investigation: collection, preservation, packing, storage, dispatching and processing
2. Preparation of reagents, media, sterilization procedures
3. Recording, organization and storage, processing and analysis of laboratory generated data
4. Different techniques used for disease diagnosis and investigation
 - 4.1. Histopathological techniques
 - 4.2. Microbiological (bacteriological and virological) techniques
 - 4.3. Fungal staining
 - 4.4. Serological techniques
 - 4.5. Parasitological techniques
 - 4.6. Cell and tissue culture
 - 4.7. Biochemical techniques
 - 4.8. Molecular techniques
 - 4.9. Standardization of drugs, vaccines and reagents

5. Laboratory safety measures
6. Introduction to biosecurity
7. First aid treatment in laboratory accidents
8. Laboratory equipment preparation and operation procedure
9. Care and management of laboratory animals

J. Others

1. Inception of Nepal agricultural Research Council. Its mandate, goals, objectives and organizational set up. NARC Act 2048 B.S.
2. Livestock sector in APP – brief introduction and projection
3. Research prioritization and approach
4. Current research programs and activities on livestock commodities
5. Recent five-year plans and agriculture in general and livestock sector in particular-priority focuses and achievements in terms of income generation and poverty alleviation.
6. Transboundary Animal Diseases
7. OIE, WTO, SPS, TRIPS, ADS
8. Quarantine system in Nepal
9. Epidemiological reporting system of Nepal
10. Recent Livestock statistics of Nepal-productivity status and contribution to AGDP from various species in terms of milk meat, draught power, wool and eggs
11. Import and export situation of livestock and livestock products in Nepal.
12. Major constraints on livestock production, marketing and expansion of livestock based industries
13. Development of research programs on national priorities

*

**
