

नेपाल सरकार
नेपाल कृषि अनुसन्धान परिषद्
पदपूर्ति समिति

वरिष्ठवैज्ञानिक एस. ३ पद/तहसवै उपसमुहको खुल्लातथाआन्तरिक प्रतियोगितात्मकलिखित परिक्षाको लागिपाठ्यक्रमएवं परिक्षा योजना

यस पाठ्यक्रमलाई दूई चरणमाविभाजनगरिएको छ ।

प्रथम चरण:लिखित परिक्षा (Written Examination)

पुर्णाङ्क: २००

द्वितीय चरण:अन्तरवार्ता (Interview)

पुर्णाङ्क: ३०

प्रथम चरण:लिखित परिक्षा योजना (Written Examination Scheme)

Paper	Subject	Marks	Full Marks	Pass Marks	No. Questions and Weightage	Time Allowed
I	Part I: Management	25	75	80	5 x 5 =25 (Short answer)	3.00 Hrs
	Part II: Agricultural Research and Development	50			4 x 5 =20 (Short answer) 3 x 10 =30 (Long answer)	
II	Technical Subject		125		5 x 15 =75 (Critical Analysis) 2 x 25 =50 (Problem Solving)	3:00 Hrs

द्वितीय चरण:(Second Phase)

Paper	Subject	Full Marks	Time Allowed
	Interview	30	Oral

द्रष्टव्य:

- लिखित परिक्षाको माध्यमभाषा नेपालीवाअंग्रेजीअथवा नेपाली र अंग्रेजीदूवै हुन सक्नेछ ।
- वैज्ञानिक समुहका सवै उपसमुहको लागिप्रथमपत्रको पाठ्यक्रमको विषयवस्तु एउटै हुनेछ । तर द्वितीयपत्रTechnical Subjectको पाठ्यक्रमउपसमुहअनुरूप फरक फरक हुनेछ ।
- प्रथमपत्रको लिखित परिक्षा सवै उपसमुहकालागि संयुक्त रूपमाएउटै प्रश्नपत्रबाट एकैदिनवा छुट्टा छुट्टै प्रश्नपत्रबाट छुट्टा छुट्टै दिनपनि सकिनेछ । यसैगरी द्वितीयपत्रको परीक्षापनिउपसमुहअनुसार अलगअलग छुट्टा छुट्टै प्रश्नपत्रबाट हुनेछ ।
- प्रथमपत्रको Part I र Part IIको उत्तरपुस्तिका छुट्टा छुट्टै हुनेछ भने द्वितीयपत्रको लागिप्रत्येक प्रश्नकाउत्तरपुस्तिकाहरु छुट्टा छुट्टै हुनेछन् ।
- पाठ्यक्रममाभएकायथासंभव सवै पाठ्याशंहरुबाट प्रश्न सोधिनेछन् ।
- यस पाठ्यक्रममा जे सूकै लेखिएको भएतापनिपाठ्यक्रममा परेका ऐन, नियमहरु, परीक्षाको मितिभन्दा ३ महिनाअगाडी (संशोधनभएका संशोधितभई हटाईएकावाथप गरी शंसोधितभई कायम रहेका) लाई यस पाठ्यक्रममा परेको संभन्नु पर्दछ ।

नोट: यस पुर्व (मिति २०७३ आश्विनभन्दा अघि) We-siteमा राखिएको सवै उपसमुहको पाठ्यक्रम सोहीउपसमुहको द्वितीयपत्रको पाठ्यक्रमकायमगरिएको छ र द्वितीयपत्रको प्रश्नपत्रको मोडेल माथिPaper II Technical Subjectमाउल्लेख गरिए बमोजिम नै हुनेछ ।

Nepal Agricultural Research Council (NARC)
Syllabus for Senior Scientist (S-3)
Open and Internal Competition Examination

Paper I: General Subject
(Management and General Agricultural Research & Development Issues)

Part I: Management

1. Management: concept, principles, functions, scope, type, role, level and skills of managers.
2. Time management: concept, advantages and disadvantages.
3. Conflict management: concept, approaches to conflict, levels of conflict, causes of conflict and strategies for conflict management.
4. Stress management: Concept, causes and sources of stress, techniques of stress management.
5. Financial management: concept, approaches, budget formulation, and implantation, auditing and topics related to fiscal management.
6. Human resources management: concepts, functions, and different aspects.
7. Leadership: concept, functions, leadership styles, leadership and management effectiveness.
8. Coordination: concept, need, types, techniques and approaches for effective coordination.
9. Motivation: Concept, theories of motivation, reasons for low productivity, techniques of employ motivation.
10. Use of Information and Communication Technologies (ICTs): concept, types, advantages & disadvantages, impact, status in Nepal.
11. Agricultural research project planning and management: concepts, principles, nature, instruments and steps.
12. Decision making: importance, types, rational process of decision process.
13. Agriculture research farm management.

Part II: Agricultural Research and Development Related Issues:

1. Present constitution of Nepal: Food, agriculture and natural resources related issues.
2. National Agricultural policies and plans: National Agriculture Policy-2061, Agricultural biodiversity policy-2063, Climate change policy 2067, Agriculture Development Strategy (ADS), Long term seed vision and agriculture related issues in current development plan.
3. Structure and responsibilities of Nepal Agricultural Research Council (NARC) as a National Agricultural Research System (NARS) in the context of global and national perspectives.
4. International Agricultural Research Organizations – CGIAR and IARCS: CIAT, CIMMYT, CIP, ICRISAT, ICARDA, World Fish, ICRAP, IFPRI, IITA, ILRI, Bioversity, IRRI, IWMI, AVRDC, ICIMOD, IFDC, IFAD, FAO.
5. Agricultural Innovation System: concept, actors, relationship between actors and accountability to stakeholders.
6. Agricultural research project management: Problem & objective tree analysis, logframe development, effect and impact assessment and its linkage with technology users.
7. Coordination and partnership of Nepal Agricultural Research Council with that of national organizations, international organizations, civil societies, entrepreneurs and agri-business.

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Sub Faculty - AgriEngineering

1. General Agriculture:

- 1.1 Principles of crop husbandry
- 1.2 Crop calendar, cropping pattern and cropping intensity
- 1.3 Farming systems in Nepal
- 1.4 Production systems of major cereal crops of Nepal
- 1.5 Cultivation of major vegetables, fruits and cash crops
- 1.6 Agro-meteorological data recording and analysis
- 1.7 Introduction to sunshine recorder, rain gauges, cup anemometer, hygrometer thermometers, pan evaporator

2. Policies and Plans for Agriculture Development in Nepal:

- 2.1 Agriculture policy 2063
- 2.2 Irrigation policy 2060
- 2.3 Agriculture in 10th five year plan
- 2.4 Major objectives of Three Year Interim Plan (TYIP)

3. Agricultural Research and Developments:

- 3.1 Problems identification, planning and methodology of agricultural research
- 3.2 Priority and needs of agricultural research in Nepal
- 3.3 Established practices of agricultural research in Nepal
- 3.4 Objectives, functions and structures of National Agriculture Research Council (NNARC) and National Agriculture Research Institute (NARI)
- 3.5 Research, Development and Extension system in Nepal
- 3.6 Research designs, implementation, data collection, analysis and presentation
- 3.7 Projects concept notes, project proposals and appraisal

4. Farm Power and Machinery:

- 4.1 Sources of farm power and scope of mechanization in Nepal
- 4.2 Work, power and energy
- 4.3 Workshop technology, organization and management
- 4.4 Fluid mechanics (compressible and incompressible fluids, viscosity, Bernoulli theorem, Archimede's principle, buoyancy)
- 4.5 Thermodynamics (laws of thermodynamics, carnot engine, entropy, enthalpy, kinetic theory of gases)
- 4.6 Basic knowledge on thermal energy conversion, fossil fuels, bio-fuels and refrigerants.
- 4.7 Introduction to theory machines
- 4.8 Machine elements the material of construction
- 4.9 Design criteria of agricultural machines
- 4.10 Internal combustion engines (petrol and diesel engines)

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- 4.11 Engine terminologies
- 4.12 Cams, gears, flywheels, governors, clutch, brakes, bearings, belt drives, threaded fasteners, conveyors, riveted and welded joints
- 4.13 Power trains and traction devices of farm tractors and power tillers
- 4.14 Types of earth moving machinery and working principles
- 4.15 Seedbed preparation machinery
- 4.16 Seeding, harvesting and threshing machinery
- 4.17 Agriculture processing and plant protection machinery
- 4.18 Dairy machinery
- 4.19 Machine and equipment for intercultural operation and plant protection
- 4.20 Resource conservation technology and required machinery, zero tillage and minimum tillage
- 4.21 Testing, modification, adaptation, safety measures and extension of agricultural machinery
- 4.22 Analysis of cost of operation and depreciation of agricultural machinery
- 4.23 Criteria for the selection of appropriate farm power and machinery
- 4.24 Storage and management of agricultural machinery
- 4.25 Identification of research issues and mechanization problems

5. Post-Harvest and Processing:

- 5.1 Grain drying, theory and practice
- 5.2 Technology of parboiling and milling of rice
- 5.3 Processing and preservation of foods and seeds
- 5.4 Design, construction, testing and evaluation of solar dryer of vegetables and fruits
- 5.5 Unit operation in processing of cereals, pulses, oilseeds, vegetables and fruits
- 5.6 Cleaning, grading, preservation and packaging of cereals, fruits and vegetables
- 5.7 Storage requirements for cereals grain, fruits and vegetables
- 5.8 Design requirements for fruit and vegetable processing plants
- 5.9 Process of value addition on various agricultural products

6. Farmstead Planning and Agricultural Structures:

- 6.1 Planning of farmstead (farm buildings, farm roads, fish ponds, electricity, water supply, storage structures, sewerage and drainage etc)
- 6.2 Design and construction of animal shelters, poultry house, godowns and various storage structures
- 6.3 Engineering materials (sand, stone, aggregate, brick, cement, steel, timber, paints etc)
- 6.4 Design of steel and RCC structures
- 6.5 Surveying (measurement of horizontal and vertical distance, angles and directions, plane table, topographic, area and contour surveying)
- 6.6 Preparation of contour maps, layout plans
- 6.7 Building construction technology (brick and stone masonry, concreting, damp proofing, flooring, plastering, carpentry and paintings)

6.8 Rate analysis, estimating and costing of engineering structures

7. Soil, Water, Irrigation and Drainage:

- 7.1 Soil-water-plant-environment relationship, evaporation, transpiration, consumptive use, estimation of evapo-transpiration and crop water requirement
- 7.2 Soil water retentions and movement-saturated and unsaturated flow
- 7.3 Soil moisture tension, infiltration and permeability
- 7.4 Sources of water
- 7.5 ground water recovery, aquifers, hydraulics of wells, design of irrigation wells and well construction procedure
- 7.6 Irrigation water lifting devices, centrifugal pumps, turbine pumps, submersible pump
- 7.7 Pump selection, power requirement, efficiency and economics of irrigation pumping plants
- 7.8 Measurement of irrigation water, weirs, parshall flume, orifices, meter-gates, flow-meter, tracer methods
- 7.9 Water conveyance and control system, surface water distribution system, underground pipe line irrigation distribution system, design of open channel
- 7.10 Irrigation water application methods, border, basin, furrow, pressurized method of water application, irrigation efficiencies
- 7.11 Land leveling, grading and field layout, survey and design, construction equipment, contour, bench and laser leveling
- 7.12 Salt problems in irrigated agriculture
- 7.13 Plant response to saline and alkaline soils
- 7.14 Reclamation and management of salt affected soils
- 7.15 Quality of irrigation water
- 7.16 Drainage investigation and effect on crop production
- 7.17 Methods of drainage
- 7.18 Layout of fields for efficient irrigation and drainage systems

Nepal Agricultural Research Council (NARC)
Syllabus for Senior Scientist (S-3)
Open and Internal Competition Examination

Subject: Agriculture Extension, Agri-economics and marketing

A. Agricultural Extension:

1. General:
 - a) Establishment, objective, roles and activities of Nepal Agricultural Research Council.
 - b) Agriculture in recent 3-years interim plan in Nepal.
 - c) Present agricultural development issues.
 - d) Main constraints for agricultural research and agricultural production in Nepal.
2. Concept of extension:
 - a) Need for extension in agriculture.
 - b) Concept, scope, principles, philosophy and objectives of extension education.
 - c) Function of extension.
 - d) Historical perspective of agricultural extension in Nepal.
 - e) Extension education as a profession and discipline.
3. Teaching learning process in extension:
 - a) Extension teaching methods – their effectiveness and limitation.
 - b) Criteria for effective extension teaching.
 - c) Adult learning – theories and principles.
 - d) Effective learning.
4. Communication in agriculture extension:
 - a) Communication process and methods.
 - b) Critical factors in extension communication.
 - c) Usage of audio – visual aids.
 - d) Communication skills, roles of extension agents.
5. Innovation, technology transfer/adoption:
 - a) Technology innovation process, generation and development process.
 - b) Diffusion, dissemination and adoption of innovation/technology.
 - c) Adoption process, stages of adoption, adopter categories and factors affecting adoption.
 - d) Traditional and recent approaches in transfer of agricultural technology.
 - e) Role of extension, research and farmer in technology generation and diffusion.
6. Group dynamics and leadership in extension:
 - a) Group dynamics and leadership development in agriculture extension.
 - b) Farmer's group formation, mobilization and characteristics of effective group.
 - c) Leadership style, typology and behaviour.
 - d) Conflict management, sources and resolution techniques.
7. Agricultural extension programme planning:
 - a) Participatory programme planning – planning methodology, planning cycle and stages.
 - b) Bottom –up planning.

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- c) Projectization concept in program planning.
- d) Participatory monitoring and evaluation – concept and process.
- e) Report writing.

B. Agricultural Economics and Marketing:

1. Production economics and farm management:
 - a) Nature and process of demand and supply of agricultural inputs.
 - b) Agricultural land use pattern and cropping system.
 - c) Use of agricultural inputs and productivity in Nepal.
 - d) Status of seed production of different crops and its supply management.
 - e) Globalization.
2. Agricultural market and price:
 - a) Agricultural price policy.
 - b) Relation between agricultural production and market management.
 - c) Role of agriculture sector in economic development and regional balance.
 - d) Agricultural market research system.
 - e) Potentialities and challenges of agricultural development in Nepal.
 - f) Bilateral treaty/ Negotiation between India, China and Bangladesh in relation to export of different agricultural commodities from Nepal.
 - g) Role of agriculture market and economic liberalization.
 - h) Agricultural market management.
 - i) Concept of co-operative market system.
 - j) Role of private sector and women's participation in agricultural production and market management.
 - k) Status of commercial trade under SAPTA and SAFTA.

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Subject: Agronomy

A. Agronomy

1. General

- a) Nepal Agriculture Research Council: establishment, objective, role and activities
- b) Agriculture in recent Five Year Plan in Nepal,
- c) Present agricultural issues,
- d) Situation of Nepal
- e) Export and import of agricultural commodities,
- f) Seed and fertilizer distribution sources in Nepal,
- g) Agricultural marketing,
- h) Main constraints for agricultural research and agricultural production in Nepal,
- i) Importance of Agronomical research in relation to WTO.

2. Research Management

- a) Planning monitoring and evaluation,
- b) Research project proposal,
- c) Research programming and budgeting,
- d) Motivation and development,
- e) Qualities and environment required to be successful scientist in Nepalese condition,
- f) Work plan and job description,
- g) Reports and technical writing,
- h) Leadership
- i) Linkage of NARC with DOAD, IAAS and other related agencies

3. Climate and Weather

- a) Climate-temperature, humidity, wind pressure, rainfall, effective rainfall, sunshine hours, soil temperature,
- b) Instruments used for different weather observation in Nepal,
- c) Climate of Nepal – climatic zones, moisture classes their features and vegetation
- d) Effect of adverse climates in Agriculture.

4. Crop Production

Study on rice, wheat, maize, finger millet, barley, buckwheat, amaranths, lentil, soybean, chickpea, pigeon pea, mungbean, rapeseed, mustard seed, groundnut, sugarcane, jute, tobacco, cotton, potato, tea and coffee with respect to:

- a) Introduction
- b) Origin and distribution
- c) Botany
- d) Morphology and growth stages of plant
- e) Climate and soil

- f) Recommended varieties and pipe-line cultivars
 - g) Physiology
 - h) Cultural practices:- land preparation, seed treatment, planting methods (spacing), planting time, seed rate, planting (seeding) time, inter-culture, harvesting, drying, cleaning, transportation, storage.
 - i) Weed and weed control:- Importance of weed, recommended herbicides and their use, method and time of application,
 - j) Manures and fertilizers - recommended doses, method of application, time of application,
 - k) Water management - time and frequency of water application, irrigation methods, water requirement, drainage,
 - l) Typical cropping calendars and cropping patterns in hills, mid-hills, terai and inner-terai,
 - m) Economics of crop production of major crops (rice, maize, wheat, sugarcane, tobacco, cotton, jute, potato, lentil),
 - n) Plant protection measures - causal agent, symptoms and control measures, IPM, use of plant pesticide.
5. Tillage
- a) Tillage - Objective of tillage, significance of tillage,
 - b) Importance of tillage in crop production,
 - c) Zero tillage, minimum tillage and optimum tillage,
 - d) Condition of soil suitable for cultivation,
6. Land Resources
- a) Physiographic distribution of Nepal - land system,
 - b) Land capability and irrigation suitability,
 - c) Land utilization
 - d) Soil of Nepal and their classifications
7. Weed and Weed Control
- a) Classification of weeds, its importance in crop production, pattern of weed distribution
 - b) Common weeds found in major field crops
 - c) Herbicides – types of herbicides, herbicide formulation, mode of action, physiology of herbicides, application method and type of nozzle for herbicides, herbicides use in Nepal
 - d) Weed control in important crops – rice, wheat, maize, finger millet, lentil, soybean etc,
 - e) Economic use of herbicides.

8. Soil and Fertilizer

- a) Soil definition, soil and sub-soil, importance of top soil and sub-soils,
- b) Soil texture, soil structure, soil bulk density, soil consistency and their importance in agriculture,
- c) Classification of essential elements on the basis of their functions,
- d) Functions and deficiency symptoms of essential elements,
- e) Determination of nutrient requirement of major crops,
- f) Soil pH, its measurement, liming material available for correcting soil pH, reaction of liming material when applied in soil,
- g) Soil organic matter, nutrient content of different animal dung, importance of organic matter,
- h) Recommended dose of nutrients, method of application and time of application,
- i) Recommendation of N,P, and K on the basis of soil analysis,
- j) Green manure- benefit of green manure, green manuring and green leaf manuring, influence of leguminous green, manure, desirable characteristics of green manure, plant suitable for green manure, green manuring and the maintenance of soil fertility, aerobic and anaerobic decomposition and its effect on soil, constraints of green manuring

9. Farming System and Outreach Research

- a) Introduction to farming system, system approach in agriculture, component/determinants of farming system,
- b) Social, economic and institutional aspects of farming system,
- c) On farm farming system research methodology, characteristics of FSR, framework of FSR methodology, diagnostic phase (RRA, Agro ecosystem, analysis, conventional survey)
- d) Gender perspective of technology generation and adoption

10. Sustainable Agriculture

- a) Definitions
- b) Differences between Modern and sustainable agriculture
- c) Problem of Modern agriculture
- d) Management practices
- e) Positive and negative points of sustainable agriculture and modern agriculture
- f) Impact of green revolution

11. Agri-environments

- a) Classification
- b) Technology generation and adoption

12. Principles of Plant Breeding

- a) Definition, importance, history and achievement of plant breeding,
- b) Heredity, growth and assimilation,

- c) Genotypes and phenotypes,
- d) Mode of reproduction in crop plant,
- e) Methods of breeding in field crops,
- f) Classification of crops according to pollination,
- g) Germplasm collection, evaluation, utilization and conservation,
- h) Varietal improvement work procedure in Nepal,
- i) Seed production techniques- types of seeds and purity maintenance of crop varieties,
- j) Method of hybridization to improve major field crops

13. Seed Technology

- a) Seed formation, development and composition,
- b) Physiology of seed,
- c) Seed quality and seed classes,
- d) Principles and practices of seed production,
- e) Seed testing principles,
- f) Seed certification procedures and seed certification standards in major crop in Nepal,
- g) Seed and fertilizer distributing agency and legislation

14. Statistics

- a) Probability and simple statistics
- b) Estimate of error - replication and randomization,
- c) Control error - blocking, field plot technique, data analysis,
- d) Complete randomized design (CRD) - randomization, layout, analysis of variance, interpretation of results
- e) Randomized complete block design (RCBD) - layout, randomization, analysis of variance, interpretation of results
- f) Latin square design - randomization, layout, analysis of variance, efficiency of row and column - blocking, interpretation of results
- g) Lattice design - balanced lattice design, partially balance lattice - layout, randomization, analysis of variance, interpretation of results
- h) Two factorial experiment - randomization, layout, analysis of variance, interactions, interpretation of results
- i) Split plot design - randomization, layout, analysis of variance, interaction of factors, interpretation of result
- j) Strip – plot design - randomization, layout, analysis of variance, interaction of factors, interpretation of result
- k) Comparison - pair comparison by least significant difference (LSD) and Duncan's Multiple Range Test (DMRT), group comparison - between-group comparison, within group comparison, trend comparison, and factorial comparison, interpretation of results

- l) Regression and correlation and their use in agriculture research
- m) Importance and validity of statistics in agriculture

B. Plant Breeding and Genetics

1. General

- a) Status of plant breeding activities in Nepal - Rice, Wheat, Maize, Legumes, Oilseeds, Potato and Vegetables
- b) Areas of collaborations with IARCS in crop improvement
- c) Participatory plant breeding
- d) Participatory on farm research
- e) Stakeholders in research and development in Nepal
- f) Improved varieties, release processes
- g) National Seed Act: types of seeds production in Nepal
- h) APP, 10th plan and current research priorities in Agriculture

2. Plant Genetics

- a) Cell division
- b) Linkage and crossing over
- c) Probability and its application in plant breeding
- d) Gene action and partition of genetic variance
- e) Heterosis and inbreeding
- f) Heritability
- g) Quantitative and qualitative traits, their gene action and interaction
- h) Gene interaction
- i) Combining ability
- j) Basic concept of molecular biology – gene structure, regulation, and manipulation
- k) Population genetics and its structure
- l) Quantitative genetics and Hardy-Weisberg law.

3. Plant Breeding

- a) Self and cross pollinated crops
- b) Breeding methods for self and cross pollinated crops and vegetatively propagated crops
- c) Breeding objective and Priority setting
- d) Breeding for insect and disease resistance
- e) Breeding for stress factors
- f) Mutation in crop improvement
- g) Poliploidy and its use in plant breeding
- h) Distant hybridization in plant breeding
- i) Male sterility and its application in crop improvement
- j) Genotype X Environment interaction
- k) Hybrid seed production

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4. Plant Genetic Resources
 - a) Germplasm collection, conservation and utilization
 - b) Biodiversity and its significance to community and country
 - c) WTO: its significance to Nepal
 - d) Plant breeders' right / Intellectual property right
 - e) Patentship of variety and product – significance to Nepal

5. Biotechnology in crop improvement
 - a) Genes and molecular basis of inheritance of characters
 - b) DNA, RNA gene structure and their regulation
 - c) Plant biotechnology
 - d) Tissue culture, cell culture, embryo culture, anther culture
 - e) Somatic hybridization
 - f) Genetic engineering in plants
 - g) Molecular markers and their use in plant breeding
 - h) Achievements and future of molecular breeding

6. Seed Technology
 - a) Seed Act in Nepal
 - b) Seed classes, seed production, certification
 - c) Formal and informal seed production system in Nepal
 - d) Community level seed production –Constraints and opportunity
 - e) Seed production: self and cross pollinated crops

7. Agricultural statistics
 - a) Field plot techniques
 - b) Experimental designs
 - c) Chi-square test, probability
 - d) Analysis of variance and covariance
 - e) Correlation and regression analysis
 - f) Stability and adaptability analysis –new techniques
 - g) Computer packages and its role in data processing

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Subject: Entomology

- 1 Insect Systematics
 - 1.1 Survey of class insecta
 - 1.2 Major tasks of systematics
 - 1.2.1 Identification
 - 1.2.2 Purpose of identification
 - 1.2.3 Methods of identification
 - 1.2.4 Problems encountered in identification
 - 1.3 Description: morphological, physiological, ecological, ethological, geographical and molecular genetic characters
 - 1.4 Concern with the proper application of the rules of nomenclature study of speciation
 - 1.5 Classification
 - 1.6 Nomenclature
 - 1.7 Insect dominancy on the earth

- 2 Insect Physiology
 - 2.1 Integument – cuticle structure and formation
 - 2.2 Moulting physiology
 - 2.3 Hemolymph physiology – composition, function, hemocytes and immune response
 - 2.4 Neuroendocrine glands
 - 2.5 Hormones: structures and functions
 - 2.6 Endocrinology of moulting and metamorphosis
 - 2.7 Central nervous system – structure and function
 - 2.8 Sensory physiology – vision, mechanical and chemical
 - 2.9 Semiochemicals – pheromones
 - 2.10 Diapauses physiology

- 3 Insect Ecology
 - 3.1 Ecological role of insect pests
 - 3.2 Dynamics of insect life systems
 - 3.3 Effects of environment on insect development
 - 3.4 Regulation of insect population

- 4 Biological Control of Insect – pests
 - 4.1 Brief history of biological control
 - 4.2 Theory behind classical biological control
 - 4.3 Agents of biological control
 - 4.3.1 Parasites and parasitoids
 - 4.3.2 Predators
 - 4.3.3 Pathogenic microorganisms

- 4.4 Practice of biological control
 - 4.4.1 Introduction
 - 4.4.2 Augumentation
 - 4.4.3 Conservation of natural enemies

- 5 Insecticide Toxicology
 - 5.1 Principles of insecticide toxicology
 - 5.2 Insecticide classification, Mode of action, Metabolisms
 - 5.3 Environmental Effects of Insecticide
 - 5.4 Selectivity and Resistance to Insects.
 - 5.5 Insecticides in Nepal and Their Classification by Hazard
 - 5.6 Pesticide residue in plants and their products
 - 5.7 Pesticide Act, 2048 and Rules 2050
 - 5.8 FAO's International Code of Conduct on the Distribution and Uses of Pesticides
 - 5.9 GIFAP Code of Pesticide formulation
 - 5.10 Insecticides and Issues on Persistent Organic Pollutants (POPs)
 - 5.11 Developing pesticide resistance insects and their management

- 6 National Insect Pests of Agriculture, Their Life Histories, ecology and Management
 - 6.1 Stem borers: (*ChiloPartellus*) in maize; *Chilosuppressalis*) in rice; *Sesamiainferens*) in wheat
 - 6.2 Brown plant hopper (*Nilaparvatalugens*) in rice
 - 6.3 Gandhi bug (*Leptocorisachinensis*) in rice
 - 6.4 White grubs (*Melolontha* sp.; *phyllophaga* sp.; *Holotrichia* sp.) in maize
 - 6.5 Cutworm (*Agrotisipsilon*; *A. segetum*) in potato
 - 6.6 Peach-potato aphid (*Myzuspersicae*) in potato
 - 6.7 Pumpkin fruitfly (*Bactroceracucurbitae*) in cucurbit vegetable fruits
 - 6.8 Red ants (*Dorylusorientalis*) in potato
 - 6.9 Shoot and fruit borer (*Leucinodesorobonalis*) in eggplant
 - 6.10 Tomato fruit worm (*Helicoverpaarmigera*) in tomato
 - 6.11 Oriental fruitfly (*Bactroceradorsalis*) in sub-tropical fruits
 - 6.12 Citrus psylla (*Diaphrinacitri*) in citrus
 - 6.13 Banana weevil (*Cosmopolites sordidus*; *Odoiporuslongicolis*) in banana
 - 6.14 Pomegrante butterfly (*Deudorysepjarbas*; *viracholaisocrates*) in pomegranate
 - 6.15 Apple wooly aphid (*Eriosomalnigerum*) in temperate fruits
 - 6.16 San Jose scale (*Quadrspidiotusperniciosus*) in temperate fruits
 - 6.17 Grain weevil (*Sitophiluoryzae*) in stored wheat grain
 - 6.18 Grain legume bruchid (*Callasobruchuschinensis*) in stored grain legume
 - 6.19 Pest lists and regulated/non-regulated quarantine insect pests of Nepal.

- 7 Insect Vectors of Plant Pathogens
 - 7.1 Aphids
 - 7.2 Leafhoppers
 - 7.3 Planthoppers
 - 7.4 Whiteflies and
 - 7.5 Beetles

- 8 Biotechnology in Entomology
 - 8.1 Plant Protection Tool to suppress insect pests
 - 8.2 Merit and demerit of the technology
 - 8.3 Genetically modified organism (GMO) issues
 - 8.4 Living modified organism (LMO) issues

- 9 Integrated Pest Management (IPM)
 - 9.1 The pest – management concept
 - 9.2 Ecological aspects of pest management and Agro Ecosystem Analysis
 - 9.3 Economic decision levels for pest populations
 - 9.4 Tactics of pest management
 - 9.4.1 Plant resistance in pest management
 - 9.4.2 Parasitoids and predators in pest management
 - 9.4.3 Use of diseases in pest management
 - 9.4.4 Use of botanicals
 - 9.4.5 Insecticide in pest management
 - 9.4.6 Attractant, repellents and genetic control in pest management
 - 9.4.7 Integration of different pest management options.
 - 9.5 The quantitative basis of pest management: sampling and measuring
 - 9.6 History and Progress of IPM in Nepal
 - 9.7 Farmer Field School

- 10 Insect pest management in organic farming
 - 10.1 Bio-rational and Bio-intensive Approaches
 - 10.2 Bio-technological Approaches
 - 10.3 Bio-pesticides
 - 10.4 Graft technology with resistant materials
 - 10.5 Ecosystem Management and Biodiversity

- 11 Industrial Entomology
 - 11.1 Sericulture
 - 11.1.1 Silk Worms
 - 11.1.2 Mulberry Silkworm, its biology, rearing silkworm, diseases and natural enemies
 - 11.1.3 Eri silkworm and Tessar silkworm

Nepal Agricultural Research Council (NARC)

Syllabus for Senior Scientist (S-3)

Open and Internal Competition Examination

- 11.1.4 Potential of sericulture development in Nepal
- 11.1.5 Problems and constraints in sericulture industry
- 11.2 Apiculture
 - 1.7.1 Kinds and distribution of honey bees in Nepal
 - 1.7.2 Morphology and structural adaptations in honey bee
 - 1.7.3 Behaviour and activities of honey bees in bee colony
 - 1.7.4 Foraging of bees and bee pasturage
 - 1.7.5 Types of bee hives and other accessories
 - 1.7.6 Care and management of an apiary
 - 1.7.7 Enemies and diseases of honey bees and ways to avoid them to care bee colony
 - 1.7.8 Uses of hive products and their marketing
 - 1.7.9 Bee poisoning and ways to protect honey bees from pesticides
 - 1.7.10 Honey bee pollination ecology
- 12 General Laboratory Techniques in Entomology
 - 12.1 Insect rearing in natural and artificial diet
 - 12.2 Simple methods of preparing insect collecting and rearing apparatuses in laboratory
 - 12.3 Laboratory chemicals and glassware
 - 12.4 Use of microscope
 - 12.5 Insect preservation
 - 12.6 Slide preparation
 - 12.7 Dispatching insects to experts for authentic identification
 - 12.8 Function and maintenance of laboratory equipments
- 13 Application of Statistics in Entomological Research
 - 13.1 Elements of experimentation
 - 13.2 Single factor Experiments, randomization, layout and analysis of variance
 - 13.2.1 Completely randomized design
 - 13.2.2 Randomized complete block design
 - 13.2.3 Latin square design
 - 13.3 Data transformation
 - 13.3.1 Logarithmic transformation
 - 13.3.2 Square-root transformation
 - 13.3.3 Arc sine transformation
 - 13.4 Comparison between treatment means
 - 13.4.1 Least significance difference
 - 13.4.2 Duncan's multiple range tests
 - 13.4.3 Regression and correlation analysis
 - 13.6 Chi-square test

Subject: Food Technology

01. Basic Post-harvest and Food Technology:

- Principles of food Processing and Preservation.
- Ancient practices of food preservation
- Technological development of food processing and practices
- Emerging technologies for preservation of foodstuffs/Hurdle technology, High pressure technology, etc.
- Aseptic techniques in food processing
- Packaging Technology- principles, materials and methods, products package compatibility, packaging and food safety, packaging technologies for emerging commodities marketing trend.
- Nutritional consideration in food processing
- Minimal processing of Food
- Post-harvest technologies of different food products: cereal grains, pulses and oilseeds, fruits, vegetables, spices, tea, coffee, etc.;
- Types of losses, Loss assessment and estimation.
- Ways to minimize post-harvest losses.

02. Food Chemistry/Bio-chemistry:

- Moisture in foods, Free and bound water, Moisture determination
- Chemistry of : fats and oils, carbohydrates, proteins, vitamins and other nutrients
- Flavor and aroma in foods
- Chemistry and analysis of: milk and milk products; meat and meat products; fruit, vegetable and their products; cereals, pulses/legumes and their products
- Chemistry and analysis of food additives and preservatives
- Chemistry of pesticides, veterinary drugs and analysis of their residues in foods
- Analysis of heavy metals, radioactivity level and other contaminants in foods and food products
- Kinetics and inhibition of enzyme catalyzed reactions
- Glycolysis and TCA cycle
- Metabolism of protein and fats

03. Policies Plans and Legislation (related to production, processing, preservation and commercialization of food products in Nepal):

- Food Security and food production strategy;
- Agriculture Perspective Plan- self sufficiency in food production, high value crops, agro-business;
- 9th and 10th Periodic Plans, Three Years' Interim Plan (TYIP)
- Constitution of Nepal,

- Agriculture Policy 2061, Agro-business promotion policy 2063, Milk policy 2064, Science and technology policy, Bio-safety policy, Food Safety Policy, etc.
- Food act 2023, Food regulation 2027, Feed act 2033, Feed regulation 2041, Consumers' protection act and regulation, Slaughterhouse and Meat inspection act and regulation,

04. Food Industries' Development in Nepal:

- History, current status and prospects of food industry development in Nepal;
- Quality management in food industries;
- Current Industrial Policy;
- Foreign Investment and Technology Transfer Act and Industrial Enterprises Act of G/Nepal;
- Agro-industrial environment of Nepal.
- Feasibility Study of Food-Industries;
- Major Issues and Challenges of Food Processing Industries in Nepal.
- Export promotion policy of G/Nepal;
- Environmental pollution control and environmental protection including IEE and EIA for food industries;
- Role of National and International Organizations such as UNIDO, APO, NARC, DFTQC, IEDI (Industrial Enterprise Development Institute), MEDEP, FNCCI, etc. for the agro- industrial development of Nepal;

05. Food Safety, Standard and Quality Control:

- Concept of Risk Analysis; Risk Assessment (Hazard identification, Exposure assessment, Hazard characterization and Risk characterization); Total Diet Study, Risk management, Risk communication.
- Food Inspection System based on Risk;
- Generic and Horizontal Standards of food; Regional and National Mandatory Food Standards;
- Cartagena Protocol on Bio-safety and GM foods;
- CAC, IPPC and OIE,
- Food Import/Export Inspection and Certification Systems;
- Traceability/Product tracing;
- General principles of food hygiene;
- National Food Control System;
- Impact Assessment of Food borne Hazards;
- Issues of Food Control in Nepal;
- GLP, ISO 17025,
- GAP, GVP, GHP, GMP, HACCP and ISO 22000;
- Food Labeling and Nutrition labeling.
- Implementation status of WFS, ICN, INFOSAN and WTO/AoA/ SPS/ TBT/ TRIPS

06 Technological Research and Development:

- Research needs and priorities in food processing,
- Adaptive and Action research,
- Project concept and proposal writing
- Logical Framework approach for Project development
- Technological problems in the existing food industries of Nepal.
- Role of NARDF, NARC, DFTQC, RECAST, IAAS and CCT (Food Tech) in post-harvest and food processing technologies.
- Research needs for traditional/indigenous food processing technologies of Nepal and their role in national economy.
- Issues and challenges of technological (food and post-harvest) development in Nepal
- Principles of packaging, materials and methods of packaging, food packages and special packaging methods, products package compatibility, packaging and food safety;
- Packaging technologies for emerging commodities, marketing trend.

07. Food and Nutrition:

- Nutritive value of food products
- Nutritional Assessment- general considerations and choice of indicators
- Nutrients and their functions
- Anti-nutritional factors and their significance in food.
- Nutrition and Degenerative diseases
- Nutrition and cancer
- Hidden hunger and Double burden of mal-nutrition
- Anthropometric and Dietary survey
- National and International organizations/institutions working in the field of nutrition.
- National Plan of Action on Nutrition
- Challenges and Issues of solving mal-nutrition problem in Nepal.

08. Basic, Food and Biochemical Engineering:

- Use of engineering concepts in developing appropriate technologies in post-harvest, food processing and packaging of agro-products;
- Importance of scaling up in food plant design,
- Basic concepts of machine and building drawing;
- Wastewater engineering, BOD, COD;
- Genetic engineering and recombinant DNA technology;
- Enzyme engineering;
- Reactor/ Fermentor and design;
- Engineering factors in food processing and concept of unit operation and unit processes;
- Material and Heat balances;

- Kinetics of chemical reactions in foods;
- Thermal process calculation, Drying/dehydration;
- Refrigeration;
- Fluid flow;
- Evaporation;

09. Food / Industrial Microbiology and Food Biotechnology:

- Spoilage and preservation of foods.
- Microbial food borne Infections and Intoxication.
- Pure culture methods.
- Food fermentation and reaction kinetics.
- Food fermentations- dairy products, lactic fermentation of vegetables, sausage, Oriental and Nepalese fermented foods;
- Single Cell Protein, Yeast production, Enzyme production; Citric acid, vinegar and amino acid production.
- Production, processing and analysis of Genetically Modified Foods.

10. Individual Products Technology:

- Fruit and vegetable processing technology
- Spices technology
- Tea and coffee processing technology
- Meat, fish and poultry technology
- Dairy technology
- Cereal technology
- Legumes and oilseed technology
- Storage and packaging technology
- Chocolate and confectionery technology
- Alcoholic and non-alcoholic beverages production technology

11. Research Methods and Statistics:

- Introduction to research methodology;
- Research problem, Research design;
- Sampling and sample design;
- Data collection, processing and analysis;
- Hypothesis testing, Chi-square test, Variance and covariance and Multivariate analysis techniques
- Averages, Dispersion,
- Correlation analysis, Regression analysis,
- Index numbers, Time series analysis,
- Probability, theoretical distributions,
- Interpolation and Extrapolation,
- Statistical quality control.

Nepal Agricultural Research Council (NARC)
Syllabus for Senior Scientist (S-3)
Open and Internal Competition Examination

Subject: Horticulture (Olericulture)

1. General

- 1.1. History, impact and importance of horticultural research and development plans and programs in Nepal.
- 1.2. Major constraints to horticultural crops production in Nepal and possible remedies.
- 1.3. History, objective, role and activities of Nepal Agricultural Research Council (NARC).
- 1.4. Organizational structure of NARC and activities of major institutions under it.
- 1.5. National and international linkages for horticultural research and development
- 1.6. Prospects of horticultural crops production.
- 1.7. Definition of horticulture and classification of horticultural plants.
- 1.8. Prioritization of horticulture crops for research and development in Nepalese context.
- 1.9. Planning, implantation and monitoring of horticultural research programs for Nepal.
- 1.10 Concept of pocket area development and satellite farming.

2. 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.

- 2.1. Potato, sweet potato, yam, colocasia.
- 2.2. Tomato, brinjal, hot chilly, sweet pepper.
- 2.3. Cauliflower, cabbage, Chinese cabbage and broccoli
- 2.4. Bean, pea, cowpea, broad bean and vegetable soybean.
- 2.5. Radish, turnip and carrot
- 2.6. Onion and garlic
- 2.7. Cucumber, bottle gourd, sponge ground, bitter gourd, pointed gourd, ride gourd, snake gourd, pumpkin and squash.
- 2.8. Broad leaf mustard, Swiss chard, cress, spinach, fenugreek, coriander, Chinese cabbages and lettuce
- 2.9. Ginger and cardamom.
- 2.10. Asparagus, artichoke, drumstick and tree tomato.

3. Organic Vegetable Production

- 3.1 Constraints and potentialities of organic vegetable production and marketing.
- 3.2 Need of research and development activities on organic vegetable production.
- 3.3 Use of non-chemical methods and means for disease management.
- 3.4 Use of non-chemical methods and means for insect pest management.
- 3.5 Use of non-chemical methods and means for soil fertility management.

- 3.6 Quality standard of organic vegetables.
- 3.7 Economics of organic vegetable production.
4. Off-season Vegetables Production
 - 4.1. Present status, constraints and potentiality
 - 4.2 Utilization of diverse agro-climatic zones for off-season vegetables production
 - 4.3 Suitable crops, varieties and months for off-season production.
 - 4.4 Protected cultivation:- Green house, lath house, plastic tunnel, hot beds, cold frame, etc.
 - 4.5 Improved cultural and management technologies and practices for off-season production.
 - 4.6 Cost and benefits of off-season vegetable production.
 - 4.7 Marketing strategies for off-season vegetable production.
5. Seed Production Technology
 - 5.1. Influence 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.
 - 5.2. Breeder, nucleus and foundation and improved production.
 - 5.3 Pollination, fertilization, seed development, dormancy and germination.
 - 5.4 Variety maintenance methods.
 - 5.5 Seed standard and field standard.
 - 5.6 Seed testing, certification and field inspection.
 - 5.7 Seed production methods for open pollinated and hybrid cultivars.
 - 5.8 Effects of harvesting time, threshing, drying, grading, packing and storage on quality of vegetable seed.
 - 5.9 Existing vegetable seed production zones and potential areas of the country.
 - 5.10 Present production, supply, demand, export and import situation of vegetable seed in Nepal.
 - 5.11 Major problems and weakness of vegetable seed research, vegetable seed production and marketing in Nepal.
 - 5.12 Seed plant technology in potato.
 - 5.13 Economics of vegetable seed production.
6. Post-harvest technology of vegetables
 - 6.1 Post harvest physiology- respiration, transpiration and ethylene production.
 - 6.2 Method of harvesting, cleaning, grading, and packaging.
 - 6.3 Post harvest handling, transportation and marketing.
 - 6.4 Harvesting of vegetables for local and distant markets.
 - 6.5 Causes of deterioration in harvested vegetables.
 - 6.6 Consumer's acceptability and quality evaluation of vegetables.
 - 6.7 Processing and preservation of vegetables, potato, ginger and cardamom.
 - 6.8 Concept of collection centers and market structures.

7. Modern Technology of vegetable Production
 - 7.1. Tissue culture and bio-technology.
 - 7.2. Drip and other micro irrigation.
 - 7.3. Plastic tunnel, plastic house and plastic mulching.
 - 7.4. Micro-nutrient, multi-nutrient, liquid fertilizers and bio-fertilizers.
 - 7.5. Latest recommended superior hybrid and superior open pollinated cultivars.
 - 7.6. Biological methods for disease and pest management.
 - 7.7. Integrated disease and pest management.
 - 7.8. Integrated soil and plant nutrient management.
 - 7.9. Post-harvest technologies on major vegetables.

8. Indigenous Technology
 - 8.1. Local and wild edible vegetables, species, cultivars and their usefulness.
 - 8.2. Indigenous practices of vegetable cultivation.
 - 8.3. Indigenous methods of disease and pest control and preventive measure.
 - 8.4. Indigenous methods of soil fertility improvement and management.
 - 8.5. Indigenous methods and management of water conservation and utilization.

9. Plant Genetic and Improvement
 - 9.1. Genes and their action.
 - 9.2. Genotypes and phenotype
 - 9.3. Homozygosis and heterozygosity
 - 9.4. Improvement of variation
 - 9.5. Breeding methods: self-pollinated species, cross pollinated species,
 - 9.6. Concept of heterocyst and development of hybrid variety.
 - 9.7. Mutation breeding
 - 9.8. Genetic erosion and transformation.
 - 9.9. Use of transgenic plants.

10. Vegetable Crop Physiology
 - 10.1. Photosynthesis
 - 10.2. Respiration
 - 10.3. Transpiration and translocation
 - 10.4. Growth and development: cell division, enlargement and differentiation.
 - 10.5. Photoperiodism, light intensity and quality.
 - 10.6. Stress physiology - temperature stresses, moisture stresses and nutrient stresses.

11. Research Methods and Management
 - 11.1. Researchable area identification
 - 11.2. Research project prioritization.
 - 11.3. Research project proposal preparation
 - 11.4. Design of experiment
 - 11.5. Exploratory research

- 11.6 Academic research
 - 11.7 Multi-disciplinary research.
 - 11.8 Multi-location research
 - 11.9 Outreach research
 - 11.10 Farmers' participatory research
 - 11.11 Socioeconomic and market research.
 - 11.12 Collaborative research.
 - 11.13 Multi-partnership research.
 - 11.14 Data base preparation.
 - 11.15 Data analysis, technical report writing and presentation
12. Biological Statistics
- 12.1 Need of biological statistics for research.
 - 12.2 Probability, frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling theory, test of hypothesis, and confidence interval, T-test, F-12.3 Test and Chi-square test.
 - 12.3 Estimate of error: - Replication and randomization.
 - 12.4 Control error: - Blocking, proper plot technique and data analysis.
 - 12.5 Complete randomized design: - Randomization, layout and analysis of variance.
 - 12.6 Randomized complete block design: - Layout, randomization, analysis of variance.
 - 12.7 Latin square design:- Randomization, layout, analysis of variance and efficiency of row and column- blocking.
 - 12.8 Incomplete block design:- Layout, randomization and analysis of variance.
 - 12.9 Two or more factorial experiment-randomization, layout, analysis of variance and interaction.
 - 12.10 Split plot design: - Randomization, analysis of variance and interaction of factors.
 - 12.11 Strip-plot design:- randomization, layout analysis of variance.
 - 12.12 Comparison:- Pair comparison by Least Significant Different (LSD) and Duncan's 12.15 Multiple Range Test (DMRT), group comparison - between-group comparison, within group comparison, trend comparison and factorial comparison.
 - 12.13 Regression and correlation:- Simple linear regression and correction, multiple-linear regression and correction, simple non-linear regression, multiple nonlinear regression.
 - 12.14 Co-variance, bi-variate and multi-variate analysis.
 - 12.15 Non-parametric tests.
 - 12.16 Qualitative data analysis.
 - 12.17 Use of statistical tools in data analysis.

Subject: Horticulture (Pomology)

1. Fundamentals of Fruit Production
 - a. Importance of fruit production in Nepal
 - b. Opportunity of fruits crops in Nepal
 - c. Climate of Nepal
 1. Temperature
 2. Humidity
 3. Pressure
 4. Rainfall
 5. Sunshine hours
 6. Soil temperature
 7. Weather observation
 8. Climatic zones and their features in Nepal
 - d. Soils of Nepal and their classification
 - e. Land resources
 1. Physiographic distribution of Nepal
 2. Land systems, land use and land capability
 - f. Orchard establishment including site selection, lay out and planting of fruit plants
 - g. Nursery management
 1. Propagating structure
 2. Media
 3. Fertilizers
 4. Soil mixtures
 5. Stratification of seeds of different fruits
 6. Nursery bed preparation
 7. Planting of grafted plants in the beds
 - h. Propagation
 1. Sexual propagation
 - Development of fruits, seeds and spores
 - Production of genetically pure seeds
 - Techniques of seed production and handling
 - Principles of propagation by seeds
 - Techniques of propagation by seeds
 2. Asexual Propagation
 - General aspects of Asexual propagation –importance of asexual propagation,
 - Reasons, changes in clones associated with age, production and maintenance of true to type clones, influence of scions in root stocks and influence of root stock on scions
 - Different types of rootstocks
 - Different types of scions and their methods of collection and preservation for later use
 - Cuttings
 - Grafting
 - Budding
 - Layering
 - Propagation by Specialized stems and roots

Micro propagation

Tissue culture

- i. Cultural practices
 - j. Factors for fruit production
 1. Human Resource
 2. Soils
 3. Water
 4. Climate
 5. Wind
 6. Light
 7. Temperature
 8. Frost
 9. Environmental potential
 10. Other factors
 - k. Training and pruning of the fruit trees
 1. Importance of pruning
 2. Different methods of pruning
 3. Effects of pruning on plant growth
 - l. Problems of Fruiting
 - m. Mango malformation
 - n. Citrus decline
 - o. Post-harvest technology
2. Study on major fruit crops like mango, banana, litchi, guava, papaya, aonla, apple, pear, peach, plum, walnut, pecan nut, almond, apricot, cherry, persimmon, avocado, grapes and citrus fruits on the following aspects:
- a. Introduction, origin and distribution
 - b. Taxonomy, Morphology and growth stages of plants
 - c. Climate and soil
 - d. Cultivars
 - e. Propagation
 - f. Planting
 - g. Cultural practices
 - h. Weed control
 - i. Manures and fertilizers
 - j. Pests and diseases
 - k. Harvesting, post-harvest handling and marketing
3. Statistics
- a. Mean, median, mode, standard deviation, standard error, frequency, probability, distribution, sampling theory, test of hypothesis, confidence interval
 - b. Estimate of error- replication and randomization
 - c. Layout designs- complete randomized, Randomized complete block, Latin square, lattice, two factorial experiment, split plot and three or more factorial designs
 - d. Comparison
 - e. Regression and correlation

- f. Importance and validity of statistics in agriculture
4. Weed and weed control
 - a. Classification of weeds and their distributions
 - b. Importance of weed control in fruit production
 - c. Common weeds of fruit orchard
 - d. Methods of weed control in fruit orchard
5. Soils and fertilizers
 - a. Soil classification
 - b. Soil moisture
 - c. Surface tension
 - d. Water holding capacity
 - e. Water movement in soil
 - f. Essential plant nutrients
 - g. Classification of plant nutrients
 - h. Functions and deficiency
 - i. Forms of nutrients utilized by plants
 - j. Chemical fertilizers- composition, classification and their uses
 - k. Process of absorption of nutrients by plant
 - l. Loss of plant nutrients from soil
 - m. Determination of nutrient requirements of the soils
 - n. Determination and removal of requirement of nutrients
 - o. Response of N.P.K. in major fruit crops
 - p. Soil pH, its measurement, limiting materials available for correcting soil pH, reaction of liming materials when applied in the soils
 - q. Liming and liming materials
 - r. Soil organic matters
 - s. C: N ratio -
 - t. Recommended doses of nutrients, time and methods of application
 - u. Soil organism and their functions
 - v. Green manuring
 - w. Farm yard manure and compost
 - x. Compost preparation
6. Plant Breeding
 - a. Definition and importance of plant breeding
 - b. Genotypes and phenotypes
 - c. Methods of breeding of fruit crops
 - d. Germplasm collection, evaluation and utilization
 - e. Methods of hybridization to improve fruit crops
7. Growth regulation
 - a. Photosynthesis, respiration and transpiration
 - b. Dynamics of growth
 1. Growth of individual plants
 2. Growth of plant community

3. Differential growth
4. Polarity and differentiation
- c. Growth regulators
 - Auxin, Gibberellins, and cytokines
 - Occurrences
 - Distribution
 - Metabolism
 - Degradation
 - Sources and relation to growth
 - Transport
 - Effect
 - Synthetic
 - Mechanism of action
 - Ethylene
 - Occurrence
 - Movement
 - Structure and activity
 - Regulatory action
 - Mechanism of action
 - Inhibitors
 - Chemical nature of inhibitors
 - Abscisic acid
 - Phenolic inhibitors
 - Other inhibitors
- d. Development
 - Germination and dormancy of seeds
 - Juvenility, maturity and senescence
 - Photoperiodism and flowering
 - Vernalisation and flowering
 - Genetic mechanism of flowering
 - Substance regulating flowering
 - Fruiting – pollination, fruit set, fruit growth, fruit ripening
8. General
 - a. Planning, monitoring and evaluation
 - b. Research project proposal preparation
 - c. Motivation and development
 - d. How to be a successful scientist in Nepalese condition
 - e. Report writing
 - f. Leadership
 - g. Linkage of research, extension and training
 - h. NARC, its establishment, objectives and activities
 - i. Ninth and tenth plan in relation to agriculture
 - j. Main constraints for agricultural research and development in Nepal

Subject: Plant Pathology

1. General Plant Pathology

- Importance and History of Plant Pathology
- Knowledge of Plant Diseases, their Identification and Classification
- Different Agents causing Plant Diseases
 - (a) General characteristics (morphology, nutrition, growth, reproduction), isolation, purification, taxonomy, nomenclature, classification of different fungi, bacteria, bacteria-like organisms, and mycoplasmas or mycoplasma-like organisms
 - (b) General characteristics (morphology, nutrition, growth, anatomy), isolation, taxonomy, nomenclature and classification of nematodes
 - (c) General characteristic (morphology, chemical composition, ultrastructure), isolation purification, architecture, multiplication, transmission, serology, classification, nomenclature or grouping (cryptograms) of virus, viroid and virus-like organisms and
 - (d) Characteristics of non-infectious plant disease-causing agents (environments, nutrients, pollution, improper agricultural practices, etc.)
- Infection and Disease Development
 - (a) Different mechanisms of infection by plant pathogens (Example: mechanical, chemicals, enzymes, toxins, growth regulators, etc.)
 - (b) Stages in development of plant diseases: Growth and reproduction (multiplication), dissemination (dispersal) and survival of plant pathogens
- Effects of Plant Pathogens on Host Physiology (Effects on structure, growth and reproduction of the host, photosynthesis, respiration, and translocation of water and nutrients in the host plant)
- Principles and Methods of Plant Control
 - (a) Traditional principles and different methods
 - (b) In addition to principles and methods, one needs to know problems and progress in controlling/managing plant diseases with special reference to Nepal
 - (c) Use of disease resistant varieties in Nepal: past experience and future strategy
- Economic importance, distribution, disease symptoms, casual agents, disease cycle, predisposing factors of disease developments and adopted control measures of some nationally and internationally important diseases of major crop plants caused by:
 - (a) Fungi
 - (b) Bacteria, bacteria-like organisms and protozoa
 - (c) Viruses, viroids, mycoplasma as and mycoplasma-like organisms
 - (d) Nematodes
 - (e) Phanerogamic parasites or high parasitic plants
 - (f) Environmental factors and physiological disorder

2. Plant Disease Epidemiology and Early Warning
 - Effects of Environment on Plant Disease Development e.g. temperature, moisture, wind, light, soil pH, host plant nutrition, and other environmental factors.
 - Plant Disease Epidemiology and Forecasting
 - (a) Development of plant disease epidemiology
 - (b) Elements or essential conditions for plant disease epidemics
 - (c) Forecasting of plant diseases and their epidemics, and
 - (d) Simulation models of plant diseases
 - Effect of Climate Change on Plant Disease Outbreaks
 - Recent Disease Outbreaks of Economic Importance in Nepal
3. Genetics and Plant Diseases
 - Genetics systems in plant pathogens, compatibility factors in plant pathogens, development of races, pathotypes or strains, host-pathogen interfaces, gene for gene concepts, nature of resistance in host, induced disease resistance, genetics of host resistance, tolerance, etc.
 - Recent advancements in breeding for resistance to plant pathogens in the Nepalese context which have economic implications
4. Plant Disease Control
 - Pesticides in Plant Disease Control
 - (a) History, classification and formulation of pesticides
 - (b) Evaluation of pesticides, mode of action, and factors affecting the field performance of pesticides
 - (c) Application methods and appropriate application equipments and materials for pesticide application
 - (d) Storage, handling and disposal of pesticides
 - Integrated Disease Management: Principles and application in Nepal with some important examples
5. Laboratory Plant Pathology
 - Plant pathological equipment and chemicals
 - (a) General and specific equipments and machineries used in plant pathology
 - (b) General and specific glass-wares used in plant pathology
 - (c) General and specific media to grow fungi, bacteria and other plant pathogens
 - (d) Common and specific reagents, cleaning, sterilizing, preserving, fixing, staining agents and other chemicals used in plant pathology
 - Laboratory and field techniques in plant pathology
 - (a) Survey, collection of disease specimens, specimen preservation and cataloguing
 - (b) General lab technique: Disinfection, sterilizing, isolation, staining, fixing, culturing, purification, maintenance and other lab-techniques

- (c) Disease diagnosis, pathogenicity test (Koch's Postulate), host range studies
 - (d) progression of disease, plant disease recording and methods, crop loss assessment
 - Critical assessment of service delivery efficiency and effectiveness of public sector laboratories, and potential for private sector laboratories
6. Post-Harvest Pathology
- Seed Pathology
 - (a) Seed borne diseases and seed health testing for major pathogens
 - (b) Nepal Seed Act in relation to seed pathology (Plant Pathology)
 - Storage Fungi and Mycotoxins
 - Importance of post-harvest pathology in agricultural trade
7. Plant Pathology and WTO
- Plant Protection and Plant Quarantine in Nepal
 - (a) Organizations, activities and act and rules
 - (b) Pesticide act and rules
 - Plant Pathology/Plant Protection in relation to WTO and SAPTA
 - Assessment of the Nepalese capacity in meeting WTO requirements in the case of plant disease control
8. Industrial Plant Pathology
- Mushroom: Importance of some edible mushroom, their identification and cultivation
 - Mycorrhiza and their uses in plant pathology
 - Bio-technology tools in plant pathology
 - Potential of industrial plant pathology to develop as a competitive agro-enterprises in Nepal
9. Cross-cutting areas having implications in plant pathology development
- Statistics in Plant Pathology: General knowledge on different statistical designs, tests, and other techniques to draw inferences/conclusions for different data of plant pathological origins
 - General Knowledge of Nepal Agricultural Research Council
 - (a) Its organizations, roles, objectives, importance, major activities
 - (b) Its linkages within disciplinary divisions, commodity programs, R/ARS
 - (c) Its linkages with DOA, IAAS, and other national and International organizations
 - Plant Pathology in relation to 20 years Agricultural Perspective Plan, recent past Five Year Plan of Nepal and agricultural policy of Government of Nepal (Candidates who likes to join NARC, should have some knowledge of different agricultural plans made from to time to time.)

Nepal Agricultural Research Council (NARC)

Syllabus for Senior Scientist (S-3)

Open and Internal Competition Examination

- Publication and Scientific Report Writing (Being in a scientific organization, one must have knowledge of scientific report writing and adequate knowledge to write and publish research articles in journals or periodicals based on publisher's instruction.)
- Project Concept
 - (a) Project cycle
 - (b) Different aspects of project preparation
- Project Appraisal
 - (a) Project appraisal -what, why and how?
 - (b) Some important consideration in project appraisal
 - (c) Project appraisal techniques
- Three Years Concept in Agriculture
- Scientific Project Proposal Writing
- Logical Framework Approach (LFA) of Project Formulation
 - (a) Basic principle and importance of LFA
 - (b) Process of LFA
 - (c) Component of log frame matrix
- Constructing Log Frame Matrix
- GIS and Remote Sensing: concept and application
 - (a) GIS functions with emphasis on spatial analysis
 - (b) GIS application in agricultural planning and plant pathology
 - (c) Use of remote sensing in agricultural planning
- Regional Planning and Agricultural Regionalization
 - (a) Concept of regional planning
 - (b) Need of regional planning
 - (c) Methods of agricultural regionalization
- National Agriculture Extension Strategy (NAES)
- Strength, Weakness, Opportunity and Threat (SWOT) analysis
- Implementation of Agricultural Extension Activities in Partnership and Contract-out
 - (a) Need of partnership and contracting extension programs
 - (b) Process of partnership and contract-out
 - (c) Partnership and contract-out extension program: challenges and future prospects

END

Subject: Soil Science

1. Importance of soil for the existence of plant and animal kingdoms.
2. Soil genesis and classification
 - 2.1. Weathering and soil forming process
 - 2.2. Factors of soil formation
 - 2.3. Development of soil profiles
3. Soil survey and mapping
 - 3.1. Base maps, and soil mapping
 - 3.2. Methods of soil survey and classification
 - 3.3. Application of Soil taxonomy in land use and crop production
 - 3.4. Use of remote sensing and geographic information system (GIS) in soil survey and classification.
 - 3.5. Major soil classes and their characters in Nepal.
4. Soil Physical properties
 - 4.1. Soil texture
 - 4.2. Soil structure
 - 4.3. Soil porosity, density and consistence
 - 4.4. Soil temperature, moisture and colour
 - 4.5. Infiltration, percolation and hydraulic conductivity
 - 4.6. Importance of soil physical properties in land use planning and crop production management.
 - 4.7. Techniques for measuring soil physical properties
5. Soil Chemical Properties
 - 5.1. Soil reaction (pH) and its importance in soil fertility and crop production
 - 5.2. General pH status of Nepal soils.
 - 5.3. Soil organic matter and its importance in soil health, crop production and environmental protection
 - 5.4. General soil organic matter status in Nepal soils
 - 5.5. Clay mineralogy and its major types in Nepalese soils
 - 5.6. Cation exchange capacity and its importance in soil fertility management
 - 5.7. General cation exchange capacity status in Nepalese soils
 - 5.8. Factors affecting the cation exchange capacity in soils
6. Soil fertility and plant nutrition
 - 6.1. Basic concept of soil fertility and plant nutrition
 - 6.2. Essential plant nutrients, their major function and visual deficiency symptoms
 - 6.3. Plant uptake of the nutrients
 - 6.4. Factors affecting the availability and uptake of the plant nutrients
 - 6.5. The nitrogen, phosphorus and potassium cycle
 - 6.6. Nutrient requirements and supply

Nepal Agricultural Research Council (NARC)

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- 6.7. Soil fertility evaluation techniques and their importance in crop production and environmental protections
 - 6.8. Soil fertility status of Nepal and its implication in agriculture and environment
 - 6.9. Strategy to be taken for maintaining / improving soil fertility for sustaining increased productivity under Nepalese conditions
7. Soil Acidity and liming
 - 7.1. Factors affecting soil acidity
 - 7.2. Causes of acid soil infertility
 - 7.3. Lime requirement and liming materials
 - 7.4. Potential of commercial lime production in Nepal.
 - 7.5. Constraints to commercial use of lime in Nepal.
8. Manures and Fertilizers
 - 8.1. Production, storage, handling and application of manures in Nepal
 - 8.2. Green manures and their popularity in Nepalese agriculture
 - 8.3. The desirable characters of green manure crops
 - 8.4. Fertilizer use and crops production status in Nepal
 - 8.5. Fertilizer recommendation for major crops of Nepal
 - 8.6. Fertilizer handling and storage situation in Nepal
 - 8.7. Fertilizer quality control issues in Nepal
 - 8.8. Crop response to fertilizers, manures and green manures under Nepalese conditions
 - 8.9. Major types of fertilizer products available in Nepalese market
 - 8.10. Problems emerging to the use of manures and fertilizers worldwide and particularly in Nepalese perspective
9. Soil Biology / Microbiology
 - 9.1. Soil microorganism and their importance in soil health and fertility
 - 9.2. Biological nitrogen fixation and its potential use in Nepalese agriculture
 - 9.3. Popular microbiological inoculum potential for commercial production and distribution in Nepal
 - 9.4. Major crops benefiting from biological N fixation.
10. Soil and Water Conservation
 - 10.1. Concepts and principles of soil and water conservation
 - 10.2. Causes and effects of Soil erosion
 - 10.3. Methods of soil and water conservation: traditional methods, modern technologies, watershed management approach, bioengineering approach etc.
 - 10.4. Importance of soil and water conservation in the hill and mountain region of Nepal.
11. Soil management for sustainable agriculture and environment
 - 11.1. Sloping agriculture land techniques (SALT)
 - 11.2. Integrated Plant Nutrition Management System (IPNMS)
 - 11.3. Problem soils (saline, alkaline, acid soils etc) management techniques.

Nepal Agricultural Research Council (NARC)
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Open and Internal Competition Examination

Subject: Veterinary

1. General
 - 1.1 History of Veterinary Science in Nepal.
 - 1.2 The structure, objectives and activities of Nepal Agricultural Research Council and Executive Board.
 - 1.3 Animal Health and Livestock Services Act 2055, Nepal.
 - 1.4 Slaughter house and meat inspection Act 2055, Nepal.
 - 1.5 Nepal Veterinary Council Act 2055.
2. Pharmacology
 - 2.1 Historical Development of Pharmacology.
 - 2.2 Factors altering Drug response.
 - 2.3 Principles of Drug activity.
 - 2.4 Drugs acting on the different systems of the body.
3. Bacteriology
 - 3.1 Classification of Bacteria
 - 3.2 General properties of Bacteria
 - 3.3 Bacteriological techniques
 - 3.4 Infectious Bacterial diseases
4. Virology
 - 4.1 General properties of Virus.
 - 4.2 Virus replication.
 - 4.3 Bacteriophages.
 - 4.4 Economically important viral diseases of livestock and poultry.
5. Parasitology
 - 5.1 Economically important parasite diseases of livestock and poultry.
 - 5.2 Anthelmintics Drugs.
 - 5.3 Blood protozoal diseases.
 - 5.4 Investigation of parasitic diseases.
6. Theriogenology
 - 6.1 Fertility and infertility in domestic animals.
 - 6.2 Heat synchronisation.
 - 6.3 Artificial in semination and embryo transfer.
 - 6.4 Endocrine system.
 - 6.5 Reproductive system and lactation.

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7. Pathology

- 7.1 Cell in health and disease, inflammation, healing, atrophy, oedema, infarction & metaplasia.
- 7.2 Special pathology in relation to economically important livestock diseases.

8. Veterinary Immunology

- 8.1 General feature of immune responses.
- 8.2 Immune system.
- 8.3 Serology.
- 8.4 Immunological techniques.

9. Surgery

- 9.1 Anesthesia.
- 9.2 Surgical techniques.
- 9.3 Preoperative and post-operative care.
- 9.4 General surgery of most common livestock problems.

10. Veterinary Public Health

Parasitic zoonotic diseases, Bacterial and Viral zoonotic diseases, Drug residue in animal food.

11. Special area

Transboundary Animal Diseases, OIE, WTO, SPS, Epidemiological status of Livestock diseases in Nepal, Role of Biotechnology in animal disease investigation, Quarantine in Nepal.

Subject: Livestock Products, Production and Management

Cattle (Native, crossbred cows, Yak/Nak, Chaury) and Buffalo (Murraha and Murraha crossbred)

Early Weaning Management.

Breeding and Feeding management of heifers.

Management of ET in cattle.

Care and Feeding Management and health of pregnant heifers and adult animals.

Improved Housing Management for calves, heifer and pregnant animals and

Milking animals.

Possible means of changing the calving pattern in buffalo

Use of Livestock production management technology for enhancing the high milk production.

Feeds and Feeding:

Meeting Nutrient requirement by low cost feeding for low cost milk production

Frequent feeding management for high yielding dairy animals..

Low cost feed Formulation

Milk Production:

The process of lactation

Hormonal influence in lactation

Release of milk from the udder

Establishment of pasteurizing unit for rural dairy cooperatives.

Detection of adulterant in milk.

Sheep and Goat:

Sheep and Goat Production/ Management System in the mountain , Hills and Terai of Nepal

Management system: Transhumance system and Sedentary System (Open grazing system and Stall feeding system)

Sheep Breed:

Exotic Breed for dual purpose:Polwarth, French Merino, Rambouillet

Native breed:Bhyanglung, Baruwal, Kage and Medium / Long tailed sheep

Goat Breed:

Exotic breed: used for upgrading native breed and research purpose in Nepal.

(a) Jamunapari (b) Barberi

Native breed: (a) Chyangra (b) Sinahal (c) Hill Goat (d) Terai

Sheep / Goat

Reproductive behaviour and Breeding systems

Breed Improvement

Objectives of breeding plan.

Frequent breeding System in Terai goats, hill goats and Kage sheep

Estrous synchronization, Flushing

Feeds and Feeding:

Nutrient requirement supplied through pasture and forages.

Low cost feed for dairy animals

Disease and Parasites:

Common diseases, Infectious disease, Noninfectious disease

Internal and External parasites

Management:

Management of kids / Lambs

Management of breeding does / ewes

Management of Breeding Bucks / rams

Improved housing management for goats in Hills and Terai

Meat Production

1. Growth and Carcass Quality:
2. Body Growth and Development
 - a) Anatomical Component of the animal body.
 - b) Bone and Nervous systems
 - c) Essential organs- Heart, Brain, Liver
 - d) Bones
 - e) Muscle
 - f) Fat
3. Definition of Carcass, offal (Edible and non-edible), Dressing Percentage
4. Estimation of carcass yield
5. Factors influencing the pattern of growth and development in meat animals.
6. Meat quality and yield improvement from male buffalo, sheep and goats by reconditioning
7. Constraints to meat production throughout the country.
8. Disease factors affecting the meat production in male buffalo, sheep and goats.

Wool Production (sheep and Angora rabbit)

A. Properties of wool

1. Strength and elasticity
2. Effect of moisture
3. Durability and shrinking
4. Felting and friction
5. Crimps

B. Growth and development of fleece

C. Factors affecting wool and quality

Swine Production:

Exotic breed: Yorkshire, Land race, Hampshire

Native breed: Hurraha, Chuache

Care and Management of piglets

Economic weaning of piglets

Management of weaning, gilt, pregnant sows and breeding boar.

Environmentally sound, Improved housing management for piglets, pregnant, dry sows and boar.

Use of green grass in feeding management of pig production

Poultry, Ducks, Quail and Turkey production and management:

Intensive poultry, Ducks, Quail and Turkey production system

Semi-intensive and free range system (Scavenging poultry production).

Hatching management

Brooding management

Grower management

Breeding management

Recent advances in commercial broiler / poultry production

Recent problems and constraints in commercial poultry farming.

Angora Rabbit (wool and meat) production / management

Types of prevailing buffalo, sheep and goat marketing systems

Use of draft animal power in sustainable agriculture farming system

Model village development for high milk production.

Model village development for meat production from Male buffalo, sheep and goat..

Major constraints facing by the commercial livestock industry and small holder dairy farmers.

Vision of Livestock development in 10th five year plan.

Constraints of Livestock Technology adoption in the farmer's field.

Importance of Livestock On-Farm Trail for technology transfer

Major challenges in livestock research and development

History of Livestock (Cattle, Buffalo, Sheep, Goats, Swine and Avian) Development in Nepal

Livestock (Cattle, Buffalo, Sheep, Goats, Swine) Production System in Nepal.

Prospects and Constraints of Livestock Development in Nepal.

Research Proposal Preparation and Research Methodology:

1. Competitive Research proposal Preparation
2. Research programme planning and budgeting
3. Experimental Design, Data collection and sampling (Parametric and non-parametric data).
4. Data Analysis

Nepal Agricultural Research Council (NARC)
Syllabus for Senior Scientist (S-3)
Open and Internal Competition Examination

Subject: Animal Nutrition and Feeding

1. General.
 - 1.1 Livestock and Poultry population and their distribution in Nepal.
 - 1.2 Production and productivity of livestock and poultry in Nepal and other developing and developed countries.
 - 1.3 Crop production and its impact in the livestock and poultry feeding system.
 - 1.4 Pasture, forage and agro-forestry productions in Nepal.
 - 1.5 Status of compound feeds and its ingredients in Nepal.
 - 1.6 Organic Chemistry
 - 1.6.1 Hydrocarbon
 - 1.6.2 Derivatives of hydrocarbons.
 - 1.7 Bio-Chemistry
 - 1.7.1 Introduction to Biological system
 - 1.7.2 Biological molecules.
 - 1.8 General knowledge about NARC
2. Digestion of the Feeds
 - 2.1 Digestion in non- ruminant animals and avian
 - 2.2 Microbial digestion in the ruminants.
3. Important nutrients of the feeds.
 - 3.1 Carbohydrates
 - 3.1.1 Classification of carbohydrates.
 - 3.1.2 Monosaccharide
 - 3.1.3 Oligosaccharides
 - 3.1.4 Disaccharides
 - 3.1.5 Polysaccharides
 - 3.1.6 Lignin.
 - 3.2 Lipids
 - 3.2.1 Fats
 - 3.2.2 Glyco lipid
 - 3.2.3 Phospholipids
 - 3.2.4 Waxes
 - 3.2.5 Steroids.
 - 3.3 Proteins
 - 3.3.1 Amino acid
 - 3.3.2 Structure of protein
 - 3.3.3 Properties of proteins
 - 3.3.4 Classification of proteins.
 - 3.4 Nucleic Acids.

- 3.5 Other nitrogenous compounds.
 - 3.5.1 Amines
 - 3.5.2 Amides
 - 3.5.3 Nitrates
 - 3.5.4 Alkaloids.
- 3.6 Vitamins
 - 3.6.1 Vitamin A
 - 3.6.2 Vitamin D
 - 3.6.3 Vitamin E
 - 3.6.4 Vitamin K
 - 3.6.5 Vitamin B complex
 - 3.6.6 Vitamin C
- 3.7 Minerals
 - 3.7.1 Major elements
 - 3.7.2 Trace elements.
- 3.8 Enzymes
 - 3.8.1 Catalytic action
 - 3.8.2 Nature and mechanism of enzyme action
 - 3.8.3 Factors affecting enzyme activity.
- 4. Metabolism of the nutrients.
 - 4.1 Energy metabolism
 - 4.2 Protein synthesis
 - 4.3 Fat synthesis
 - 4.4 Carbohydratessynthesis.
- 5. Evaluation of foods.
 - 5.1 Digestibility
 - 5.2 Energy content of foods and the partition of food energy within the animal
 - 5.3 Systems for expression the energy value of foods.
 - 5.4 Protein quality of foods for feeding ruminants(cattle, buffalo, sheep and goats) and non- ruminants (Poultry, pigs and rabbits).
- 6. Feeding Standards
 - 6.1 Maintenance, growth and production
 - 6.2 Reproduction
 - 6.3 Lactation
 - 6.4 Work
- 7. Voluntary intake of food.
 - 7.1 Ruminants
 - 7.2 Non-ruminants
 - 7.3 Prediction of food intake.

Nepal Agricultural Research Council (NARC)

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Open and Internal Competition Examination

8. Feeds of Livestock and Avian.
 - 8.1 Grass, Forage crops and fodder trees, Silage, Hay, Artificially dried forages, straws and chaff, Root, tubers and related by-products, Cereal grains and cereal by-products, Protein concentrates.
 - 8.2 Role of biotechnology in the feeds of livestock and avian

9. Ration Formulation
 - 9.1 Formulae for cattle/buffalo feed mixtures,
 - 9.2 Formulae of ration for sheep and goats
 - 9.3 Formulae for Swine/rabbit feed mixtures,
 - 9.4 Formulae for Poultry / Avian feed mixtures,
 - 9.5 The preparation of mixed mineral supplements,
 - 9.6 Linear programming of feed mixtures.

10. Utilizations of low quality feeds and feed stuffs
 - 10.1 Cereals, leguminous and oil seeds straw
 - 10.2 Agro-industrials by products
 - 10.3 Non-conventional feeds and feedings

11. Feedstuffs Control and Legislation.

12. Feed intake and their efficiency in improving productions and productivity.

13. Statistics
 - 13.1 Organization and description of data,
 - 13.2 Probability
 - 13.3 Introduction to statistical inference.
 - 13.3.1 Sampling distributions and estimation
 - 13.3.2 Hypothesis testing
 - 13.3.3 Experimental Design and data analysis.
 - 13.3.4 Regression and correlation
 - 13.3.5 Analysis of variance and covariance

Nepal Agricultural Research Council (NARC)
Syllabus for Senior Scientist (S-3)
Open and Internal Competition Examination

Subject: Animal Breeding and Genetics

- 1 General
 - 1.1 Animal breeding strategy in Nepal
 - 1.2 Role of NARC in genetic improvement of livestock and poultry.
 - 1.3 The structure objectives and activities of Nepal Agricultural Research Council and Executive Board.
 - 1.4 Main constraints and issues in animal genetic improvement programme in Nepal.

- 2 Basic concept of general animal genetics.
 - 2.1 Cell biology, cytogenetics, molecular genetics.
 - 2.2 Genetics of population of random mating and inbreeding, the effects of selections mutation, migration in farm animals and birds.
 - 2.3 Genetics of quantitative characters in random and non-random mating population of livestock and poultry.
 - 2.4 Application of quantitative genetics theory in breeding work of domesticated animals and birds.
 - 2.5 Anatomy and physiology of reproduction system of male and female of farm animals and birds.
 - 2.6 Environmental factors such as feeding, health care, housing and management affecting production traits in farm animals and birds.
 - 2.7 Genetic factors affecting production traits in farm animals and birds.
 - 2.8 Inbreeding and hybridization in farm animal and birds.
 - 2.9 Artificial insemination of farm animals and birds. Semen collection, freezing, thawing, and insemination technique. Gee collection from donors, freezing, storage and transfer to recipients.
 - 2.10 Evaluation of the production performances of different breeds of farm animals and birds found in Nepal and their genetic improvement.
 - 2.11 Analysis of measurement of quantitative and discrete data, analysis of variance and covariance of livestock production traits, simple linear regression and correlation of production traits, simple linear regression and correlation of production traits of farm animals and birds.
 - 2.12 Experimental design of the breeding experiment of farm animal and birds.
 - 2.13 Expected progeny differences and predicted transmitting ability of sire and dam of farm animals and birds.
 - 2.14 Animal breeding in the Nepalese social context.
 - 2.15 Breed society formation and their importance in Nepal.
 - 2.16 Improvement of reproductive efficiency of farm animals particularly in Nepalese farmer's condition.
 - 2.17 Genetic principles in animal breeding.

- 3 Population and quantitative genetics
 - 3.1 Genetic structure of populations hardy Weinberg law, sex linkage, linkage, analysis of qualitative characters, estimation of gene frequency.
 - 3.2 Changes of gene frequency mutation, migration, selection.
 - 3.3 Changes of gene frequency on small populations.
 - 3.4 Quantitative variation, gene effect , various repeatability, heritability, genetic correlations, genotypes x environment interaction.
 - 3.5 Inheritance of qualitative and quantities traits (Reproduction and fertility traits udder development, milking rate, yield and composition of milk, body size and carcass traits, wool production sits quality, production characteristics in poultry, pigs, buffalo goat and cattle.

- 4 Reproduction and physical basis of inheritance.
 - 4.1 Anatomy and physiology of reproductive organs of male and female of farm animals and birds.
 - 4.2 Physical basis of inheritance: Formation of germ cells spermatogenesis, organsis fertilization.
 - 4.3 Artificial insemination and embryo transfer of farm animal and birds.
 - 4.4 Cryo-preservation techniques to be use in different farm species.
 - 4.5 Manipulation of germ cells, collection, evaluation, storage, transfer for different farm animals and birds.
 - 4.6 Different techniques in pregnancy diagnosis in farm animals.
 - 4.7 Hormonal regulation in growth and development from fertilization to maturity.
 - 4.8 Multiple ovulation and embryo transfer.
 - 4.9 Heat synchronization and its importance in animal breeding.
 - 4.10 Cloning and sexing of fertile egg and production of homogeneous genotypes.
 - 4.11 Genetic aspects of reproduction traits.
 - 4.12 Embryonic and fatal development, hormones in reproduction and artificial control of farm animals.

- 5 Animal genetic resource.
 - 5.1 Phenotypic and genetic characterization of different breeds of farm animal and birds in Nepal.
 - 5.2 Animal genetic biodiversity.
 - 5.3 Conservation (ex-situ/in-situ) and management of genetic resources.
 - 5.4 Breeding system in smaller population size of rare breeds.
 - 5.5 Genetic and non-genetic factors affecting conservation and maintenance of genetic resources.
 - 5.6 Issues and constraint associated with conservation of animal genetic resources in Nepal.

- 6 Genetic improvement of farm animals and birds.
 - 6.1 Genetic models and partitioning of genetic variances.
 - 6.2 Additive and dominance relationship.
 - 6.3 Coefficient of inbreeding and its effect in productivity.
 - 6.4 Crossbreeding and hybridization and estimation of hybrid vigour and their impact in genetic improvement program in Nepal.
 - 6.5 Genetic covariance between individuals.
 - 6.6 Genetic parameters and their estimation and their use in estimating breeding value of breeding animals.
 - 6.7 Methods and response to selection.
 - 6.8 Construction of selection index.
 - 6.9 General linear models for analysis of animal breeding data.
 - 6.10 Importance of multivariate regression and correlation analysis in animal breeding.
 - 6.11 Sire and dam evaluation based on their breeding values.
 - 6.12 Progeny testing and performance testing of farm animals and birds.
 - 6.13 Techniques for breed development.
 - 6.14 Bio-chemical polymorphism and their use in genetic improvement in Nepal.
 - 6.15 Genetic improvement technique for smaller herd size of Nepalese farmers.
 - 6.16 Hereditary defects and disease resistance in farm animals.
 - 6.17 Farmers participatory group breeding approach in genetic improvement program.
 - 6.18 Breeds and breed formation and development of breeding strategy.

- 7 Cellular and molecular genetics.
 - 7.1 Qualitative genetics, genes and their control in expression of economic important traits of farm animals.
 - 7.2 Molecular genetics, RNA, DNA transcription, translation and gene regulation.
 - 7.3 Developmental genetics and gene multiplication.
 - 7.4 Polymorphism and its use in animal breeding.

- 8 Bio-technology and bio-statistics.
 - 8.1 Role of biotechnology in animal breeding.
 - 8.2 Experimental design for animal breeding experiment.
 - 8.3 Breed evaluation for production and reproduction traits particularly in the smaller herds' size of farm animals in Nepalese condition.
 - 8.4 Different techniques in genetic conservation of farm animals.
 - 8.5 Analysis of animal breeding data.

- 9 Outreach animal breeding.
 - 9.1 Social aspects of rural Nepalese life.
 - 9.2 Techniques of data collection for animal breeding from farmers' herds or flocks.
 - 9.3 Characteristics of different breeds of farm animal and birds.
 - 9.4 Animal breeding problems identification in the outreach sites.

- 9.5 Organization of breeding society and its need for each breed of farm animals and birds.
- 9.6 Variation of marketing value of different superior breeding animals.
- 9.7 Reproduction efficiency of farm animals and birds.
- 9.8 A.I. and E.T. in Nepalese context.
- 9.9 Reproductive problems in farm animals.
- 9.10 Progeny testing.
- 9.11 Performance testing.
- 10 Development of breeding plans with respect Nepalese condition.
- 10.1 Cattle and buffalo
- Progeny testing and selection among tested bulls.
 - Selection of dam of bulls.
 - Selection of young bulls for testing
 - Selection of cows within herds
 - Farmers participation cattle/ buffalo breeding program
 - Buffalo breeding for milk and meat.
- 10.2 Goat
- Farmers participation goat breeding program for growth rate, fertility, carcass quality
 - Cross breeding for meat production
- 10.3 Pigs
- Selection based on sib and own performance
 - Farmers participating organized line breeding/cross breeding.
- 10.4 Sheep
- Selection for carpet wool in bhyanglung
- 10.5 Poultry
- Selection for dual purpose poultry
 - Selection for meat.
 - Experimental design factorial experiments one way and two way classification covariance analysis.
 - Linear model and mutivariate analysis.
 - Application of modern molecular genetics to animal breeding.

Nepal Agricultural Research Council (NARC)
Syllabus for Senior Scientist (S-3)
Open and Internal Competition Examination

Subject: Pasture /Forage and Agro-forestry

1. General
 - 1.1 Botany of grasses and legumes
 - 1.2 Plant Growth and Development
 - 1.3 Types of grassland and its distribution
 - 1.4 Seasonal growth curve
 - 1.5 Ruminant's digestive , productive and reproductive systems

2. Forage Physiology
 - 2.1 Cell organization , plant metabolism , nitrogen metabolism , photosynthesis and respiration.
 - 2.2 Crop seed physiology, seed development, seed dormancy, germination and other physiological processes associated with seed production and storage of economically important pasture/ forage and fodder tree seeds.

3. Forage Breeding
 - 3.1 Principles of breeding
 - 3.2 Factors to consider in breeding
 - 3.3 Breeding and improvement objectives
 - 3.4 Breeding behavior
 - 3.5 Genetic and cytogenetic
 - 3.6 Breeding methods
 - 3.7 Forage and pasture crop evolution.
 - 3.8 Application of advances in somatic genetics and tissue culture techniques in pasture improvement.
 - 3.9 Advanced nursery and plantation techniques.
 - 3.10 Advanced forest tree improvement approaches to forest tree improvement, selection, species introduction, seed orchards hybridization, mutation and progeny testing.

4. Forage Agronomy
 - 4.1 Plant introduction, evaluation and utilization.
 - 4.2 Fertilization and liming
 - 4.3 Cutting management
 - 4.4 Irrigation management
 - 4.5 Recycling of nutrients dung and urine spots
 - 4.6 Weed control and mowing.
 - 4.7 Factors affecting crop adaptation, production, utilization and conservation.
 - 4.8 Principles and practices of fodder / pasture and fodder tree production , utilization and conservation
 - 4.9 Seed testing principles, seed certification procedures, seed certification standards in major forage crops in Nepal.

- 4.10 Cropping systems, crop rotation, inter-cropping, mixed cropping, multiple cropping and mixed farming systems.
- 4.11 Marginal land utilization for pasture, forage and fodder trees.
- 5. Production Technology
 - 5.1 Production technology of forage crops
 - 5.2 Production technology of temperate species
 - 5.3 Production technology of fodder trees
 - 5.4 Seed production technology of forage crops, temperate species and fodder trees
 - 5.5 Sapling production technology in fodder trees
- 6. Grazing and Range Management.
 - 6.1 Grazing practices
 - 6.2 Aspects grazing management
 - 6.3 Efficiency of grazing
 - 6.4 Stocking rate and grazing pressure
 - 6.5 Factors affecting grazing behavior
 - 6.6 Experimentation in grazing management
 - 6.7 Principles of range management, vegetation development and soil conservation, classification of range condition, practices for range management and conservation.
 - 6.8 Fodder and feed from trees and shrubs, grassland productivity and carrying capacity, productivity influencing factors.
 - 6.9 Burning as a management practice, bush control, provision of water, range reseeding and fertilizing.
- 7. Herbage quality and Nutritive value.
 - 7.1 Nutritive value, digestibility and forage intake.
 - 7.2 Estimation of intake and digestibility, nutritive value and herbage quality and animal productivity.
 - 7.3 Feeding value of grass, legume and its products
 - 7.4 Forage quality i.e. cell wall contents, cell contents, digestibility, total digestible nutrients and metabolizable energy.
- 8. Agro-forestry.
 - 8.1 Definition, scope and advantage, classification of agro-forestry systems silvi-pasture system, agri-silvi-pasture system, productive agroforestry systems, protective agro-forestry systems, multipurpose agro-forestry systems, management of trees in agroforestry systems , Economics of agroforestry systems
 - 8.2 Shifting cultivation; shifting cultivation in Nepal
 - 8.3 Interaction in crops ; effects of trees on agricultural crops, effects of agricultural crops on trees, effects of animal on vegetation, effects of trees on animal,

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9. Forage Conservation.
 - 9.1 Principles of conservation
 - 9.2 Silage making
 - 9.3 Hay making
 - 9.4 Artificially dried forage
 - 9.5 Conserved forages for animal feeding

10. Forage Toxicology
 - 10.1 Antiquity constraints and disorders

11. Forage diseases and their control.
 - 11.1 Diseases of pasture/forage and fodder trees , seed borne , soil borne and air borne diseases.
 - 11.2 Genetics of disease resistance in pasture/forage and fodder trees , breeding for disease resistance and utilization of disease resistant genes.
 - 11.3 Biological control of pasture/forage and fodder tree pathogens.
 - 11.4 Cultural control measures of pasture/forage and fodder tree pathogens.

12. Forage insects' management and their control.
 - 12.1 Principles of insect- pest control, physical and mechanical control, cultural control, biological control , chemical control and host plant resistance.
 - 12.2 Toxicity of insecticides, precaution in the use of insecticides, insecticide-application equipment.
 - 12.3 Major pests of pasture/forage and fodder trees and their control measures.

13. Statistics.
 - 13.1 Experimental designs and data analysis (parametric and non- parametric)
 - 13.2 Regression and correlation
 - 13.3 ANOVA & ANOCOOVA.

- End -

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Subject: Fishery

- 1 Aquaculture
 - 1.1 Introduction of Aquaculture.
 - 1.2 Cultivated fish species – indigenous and exotic.
 - 1.3 History of fish culture in Nepal.
 - 1.4 Status of fish culture in Nepal- Coverage area, production (production and wild capture), contribution/ consumption.
 - 1.5 Pond fish culture
 - 1.5.1 Extensive,
 - 1.5.2 Semi-intensive,
 - 1.5.3 Intensive,
 - 1.5.4 Integrated fish culture,
 - rice cum fish culture,
 - Duck cum fish culture,
 - Pig cum fish culture,
 - Vegetable cum fish culture,
 - Livestock cum fish culture.
 - 1.5.5 Fish farm design and construction,
 - Planning,
 - Site selection,
 - Topography and layout,
 - Soil quality,
 - Pond construction,
 - Water source.
 - 1.5.6 Hatchery management,
 - i Brood fish management,
 - ii Fish breeding,
 - Natural breeding,
 - Semi-artificial breeding
 - Artificial breeding
 - iii Hatchery and nursery management
 - Hatchery design and construction
 - Incubation
 - Nursing and rearing
 - Hatchling, fry and fingerlings
 - 1.5.7 Grow out fish
 - i Pond fertilization
 - ii Fish harvest
 - iii Fish market
 - 1.6 Cage fish culture
 - 1.7 Enclosure fish culture
 - 1.8 Open water fish stocking

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- 2 Post-harvest fish technology
 - i Nutrition value
 - ii Quality control
 - iii Methods of preservation and processing
 - Fish drying
 - Fish smocking
 - Fish curing
 - Fish chilling

- 3 Water quality management

- 4 Nutrition
 - i Natural food – planktons
 - ii Artificial feed
 - Feed formulation
 - Feed preparation and nutrition value
 - Feed ingredients and major nutrients
 - Essential amino acids and minerals
 -

- 5 Fish health management
 - i Fish parasites and common fish diseases
 - ii Symptom of fish diseases
 - iii Methods of treatment

- 6 Live fish transportation

- 7 Capture fisheries

- 8 Fish biodiversity and conservation

- 9 Fish migration

- 10 Aquatic weeds and their control

- 11 Fisheries law and application

- 12 Role of fisheries and aquatic resources in food security for the poor

- 13 Women participation in fisheries and fish culture activities

- 14 Importance of cold water fish culture in Nepal-site selection, requirement of criteria, layout and construction

- 15 Prospect of fish culture in Nepal

- 16 Role of Nepal Agriculture Research Council (NARC)