

नेपाल सरकार
नेपाल कृषि अनुसन्धान परिषद्
पदपूर्ति समिति

वरिष्ठ बैज्ञानिक एस. १ 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	Full Marks	Pass Marks	No. Questions and Weightage	Time Allowed
I	Agricultural Research and Development issues	75	80	5 x 5 =25 (Short answer)	3.00 Hrs
				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 अंग्रेजीदुवै हुन सक्नेछ ।
- बैज्ञानिक 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 परीक्षापनिउपसमुहअनूसार अलगअलग छुट्टा छुट्टै प्रश्नपत्रबाट हुनेछ ।
- प्रथमपत्रको Part I र Part IIको उत्तरपुस्तिका छुट्टा छुट्टै हुनेछ भने द्वितीयपत्रको लागिप्रत्येक प्रश्नकाउत्तरपुस्तिकाहरू छुट्टा छुट्टै हुनेछन् ।
- पाठ्यक्रममाभएकायथासंभव सवै पाठ्याशंहरूबाट प्रश्न सोधिनेछन् ।
- यस पाठ्यक्रममा जे सूकै लेखिएको भएतापनिपाठ्यक्रममा परेका ऐन, नियमहरू, 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
Syllabus for Scientist (S-1)
Open and Internal Competition Examination
Paper - 1st

Part I: 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) and National Agricultural Research and Development Fund.
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, principles and steps on research project development.
7. Coordination and partnership of Nepal Agricultural Research Council with that of national organizations, international organizations, civil societies, entrepreneurs and agri-business.
8. Use of Information and Communication Technologies (ICTs) in agriculture R&D.
9. Agriculture research farm management.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Agri-Engineering

1.0 General

- 1.1.0 Research methodology
- 1.1.1 Collection of issues and problem identification specially related to Agri.Engg.and in the contest of 10th five year plan.
- 1.1.2 Research prioritization based on client's need
- 1.1.3 Preparation of research projects
- 1.2.2 Data analysis & Report writing
- 1.2.3 Knowledge of computer package
- 1.3 Basic economy study methods
- 1.4 Nepal Agriculture Research Council, establishment, objectives, role and activities
- 1.7 General recent agricultural statistics of Nepal particular to climate, irrigation, size of land holdings, energy, power available for agriculture use and productivity of main crops.

2.0 Soil and water Engineering

- 2.1 Soil – water – plant relationship and flow measurement, ET calculation, irrigation requirement for various crops, climatic factors which affect irrigation requirement.
- 2.2 Survey,design, estimate and supervision of;
 - i. Irrigation and drainage related structures
 - ii. Irrigation well construction
 - iii. Irrigation pump selection and installation
 - iv. Different soil losses soil conservation and erosion control measures
 - v. Hill torrent and gully control measures
 - vi. Land development,grading,shaping and layout
- 2.3 Economic of pumping scheme
- 2.4 Concept and practices of water resources conservation and management.
- 2.5 Water convices& control structures
- 2.6 Measurement & analysis of precipitation & run off
- 2.7 Various water harvesting techniques and other water management practices
- 2.8 Irrigation and drainage methods and design consideration. Check basin, border,furrow,sprinkler anddrip. Surface and sub-surface drainage
- 2.9 Irrigation efficiencies

3.0 Farm power and Machinery

- 3.1 Workshop management
- 3.2 Design, development and modification of farm tools implements and machinery
 - 3.2.1 Tillagemachinery and equipment
 - 3.2.2 Seeding and planting machinery and equipment

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 3.2.3 Intercultural „ „
 - 3.2.4. Plant protection „ „
 - 3.2.5 Threshing and harvesting,, „
 - 3.2.6 Design criteria
 - 3.2.7 Testing methods
 - 3.2.3 Need of modification
 - 3.3 Testing, data analysis and evaluation of machinery and equipment
 - 3.4 Cost analysis
 - 3.5 Role of agricultural mechanization in Nepal.
Selection of appropriate tools, implements and machinery for cereals, cash crops, vegetables, fruits and animal production.
 - 3.6. Various forms of renewable energy (solar, wind and biogas) and their application in agricultural operations.
 - 3.7. Various forms of farm power used in agriculture.
- 4.0 Farm structures
- 4.1 Supervision of plane and topographical surveying works.
 - 4.2 Survey, design/estimate and supervision of
 - 4.2.1 Various, farm structures such as residential quarters, office buildings, godowns, glass houses, ware houses, threshing floor, animal sheds, processing houses and cold storage.
 - 4.2.2 Facilities such as electric supply, drinking water supply and sewerage in farm building, fencing, farm roads, culvert and cause- way.
 - 4.3 Farm planning, layout and management on construction of site selection
 - i. Various farm structures
 - ii Farm facilities.
 - 4.4 Rate analysis of different construction item
 - 4.5 Planning and management of infrastructures for fish farming.
 - 4.6. Computation of depreciation of above mentioned infrastructures.
- 5.0 Post harvest engineering
- 5.0.1 Need assessment survey on post-harvest engineering
 - 5.0.2 Assessment of post-harvest losses and methods to minimize
 - 5.2.1 Harvesting and threshing losses
 - 5.2.2 Transportation losses
 - 5.2.3 Storage losses
 - 5.0.3 Properties of air vapor moistures, psychometric chart and EMC models
 - 5.0.4 Theory of aerobic and anaerobic grain storage situation
 - 5.0.5 Theory of grain drying and drying methods

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 5.0.6 Design of grain dryer and its performances
- 5.0.7 Design of grain silos
- 5.0.8 Principle of milling
- 5.0.9 Grain fumigation in rural go-down
- 5.0.10. Heat transfer methods and simple exchanger
- 5.0.11 Improved methods of processing and preservation of various agricultural produces

6.0 Statistics

- 6.1 Probability, frequency, mean, median, mode, standard deviation, standard error, normal distribution sampling theory, test of hypothesis, confidence interval
- 6.2 Estimate of error, relocation and randomization.
- 6.3 Control error blocking, proper plot technique and data analysis.
- 6.4 Complete randomized design – randomization Lay out and analysis of variance
- 6.5 Randomized complete block design, layout, randomization and analysis of variance.
- 6.6 Latin square design- randomization, layout analysis of variance,efficiency of row and column blocking
- 6.7 Lattice design- balance lattice design, partially blance lattice
- 6.8 Two factorial experiment-randomization, layout, analysis of variance and interaction.
- 6.9 Split plot design- randomization, layout, analysis of variance
- 6.10 Strip-plot design- randomization, layout, analysis of variance
- 6.11 Three and more factorial design-split-split plot design, two or three factorial design,strip split-plot design.
- 6.12. Comparison- pair comparison by least significant difference (LSD) and Duncan's Multiple Range Test (DMRT): group comparisons andfactorialcomparisons.
- 6.13. Regression and correlation:- Simple linearregression and correlation, multiple-linearregression, multiple nonlinear regression.
- 6.14 Missing plot technique.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Agri-extension, Agri-economic and Marketing

1. General
 - a) Role of agriculture in Nepalese economy
 - b) Structural characteristics of Nepalese Agriculture
 - c) HMG's long-term and periodic plans and policies on agricultural development
 - d) Problems and prospects of agricultural development in Nepal.

2. General Economics
 - a) Theory of Consumer Behavior
 - i. Utility Functions: Concept and Existence (conditions)
 - ii. Demand Functions: Ordinary and Compensated
 - iii. Price and Income Elasticity of Demand
 - iv. Revealed Preference Theory
 - b) The Theory of Firm
 - i. The Production Function
 - ii. Isoquants
 - iii. Elasticity of Substitution
 - iv. Cost Functions
 - c) Classification of Markets and their critical Appraisal
 - d) Price Determination in Different Market conditions
 - e) Welfare Economics:
 - i. Pareto Optimality – for consumption and production
 - ii. Public goods: concept and properties

3. Agricultural Economics
 - a) Concept of Farm Management and Production Economics
 - b) Farm Planning and Budgeting
 - c) Farm Records and Accounts
 - d) Major Production Relationships in Agriculture
 - i. Factor-product relationship
 - ii. Factor-factor relationship
 - iii. Product-product relationship
 - e) Technological change: Concept and impact on production function

4. Agricultural Marketing and Trade
 - a) Role of Ag marketing and trade in economic and agricultural development
 - b) Problems and prospects of agricultural marketing in Nepal.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- c) Present output marketing system of major cereals, pulses, livestock, fish and horticultural commodities.
 - d) Present marketing system of major agricultural inputs
 - e) Marketing Information System: Present status and importance in Nepal
 - f) Development and Management of Agricultural Market Centers in Nepal.
 - g) Agricultural Marketing institutions at public and private sectors in Nepal
 - h) Export and import of major agricultural commodities in Nepal
 - i) Concept of Marketing Efficiency
 - j) Concept and importance of Agricultural Marketing Research
 - k) Regional and global organizations related to trade and marketing (SAFTA, WTO)
 - l) Comparative and competitive advantage
 - i. Concept
 - ii. Analytical Techniques (Domestic Resource Cost, Implicit Tariff, Nominal Protection Rate, Effective Protection Rate)
5. Statistics/Econometrics
- a) Sampling techniques
 - b) Sample size determination
 - c) Desirable properties of estimator
 - d) Probability distribution
 - e) Hypothesis testing and confidence intervals
 - f) Classical Linear Regression Model: Assumptions
 - g) Relaxing the assumptions of Classical Model
 - i. Multicollinearity
 - ii. Heteroscedasticity
 - iii. Autocorrelation
 - h) Use of dummy variables in regression analysis
 - i) Analytical tools used in technology adoption (probit, logit, tobit)
6. Agricultural Planning
- a) Concept of planning, project, project cycle
 - b) Project Analysis
 - i. Financial and Economic Aspects
 - ii. Measures of Project Worth
 - iii. Incorporating Environmental consideration in project preparation and analysis
 - c) Participatory Planning, Monitoring and Evaluation
 - d) Market-oriented production planning
 - e) Devolution of planning to local bodies
 - f) Environmental consideration in agricultural project preparation

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

7. Agricultural Research Institutions in Nepal
 - a) NARC- objectives, role in technology generation
 - b) NARC-Present status and future prospects
 - c) NARDF
 - d) NGOs and INGOs

8. Socio-economic Research
 - a) Need and Importance
 - b) Project Concept Note and Proposal Writing
 - c) Participatory Research in Technology Generation
 - d) Assessing the Impact of New Agricultural Technology

9. Public Resource Allocation and Organizational Development in Nepal
 - a) Trend in resource allocation for agricultural development in general and agricultural research in particular.
 - b) Role of Foreign Aid in Agricultural Development: Issues and Prospects
 - c) Organizational Development in Agriculture.

10. Public Policy Analysis
 - a) Concept of Policy Analysis
 - b) The Process of Policy Making
 - c) Role of Policy analysis in Policy making process

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Plant Breeding and Genetic

1. General

- 1.1 History of agricultural research in Nepal,
- 1.2 Organizations involved for crop improvement in Nepal and their activities,
- 1.3 International institutes for crop improvement and their mandated crops,
- 1.4 Relationship of national and international research institutes in crop improvement,
- 1.5 Intellectual Property Rights (IPRs) in relation to improved varieties and plant genetic resources (Breeders' and Farmers' Rights),
- 1.6 National Seed Policy, National Seed Act and Seed Regulations and their amendment,
- 1.7 Objectives and activities of plant breeding,
- 1.8 Domestication, plant introduction, acclimatization and centers of origin of major crops.

2. Plant Genetic Resources

- 2.1 Biodiversity and agrobiodiversity,
- 2.2 Evolution of major crop species,
- 2.3 Centers of origin and centers of diversity,
- 2.4 Germplasm collection and exchange,

- 2.5 Plant exploration, conservation (*ex situ/in situ*) and management of genetic resources,
- 2.6 Evaluation and utilization of plant genetic resources,
- 2.7 Agro biodiversity policy in Nepal,
- 2.8 Status of plant genetic resources in Nepal.

3. Genetic Basis of Plant Breeding

- 3.1 Cell division and molecular biology,
- 3.2 Genetic models and partitioning of genetic variance,
- 3.3 Hybridization and selfing,
- 3.4 Modes of reproduction and pollination,
- 3.5 Inbreeding depression and heterosis,
- 3.6 Mating systems,
- 3.7 Heritability,
- 3.8 Selection and response to selection,
- 3.9 Choice of breeding methods,
- 3.10 Genotype x environment interaction,
- 3.11 Combining abilities (GCA and SCA).

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Syllabus for Scientist (S-1)
Open and Internal Competition Examination

4. Biometrical Techniques in Plant Breeding

- 4.1 Assessment of variability,
- 4.2 Genetic diversity,
- 4.3 Correlation coefficient, correlation and path analysis,
- 4.4 Diallelcross analysis,
- 4.5 Field plot techniques,
- 4.6 Experimental designs,
- 4.7 Analysis of variance and co-variance,
- 4.8 Chi-square test,
- 4.9 Stability analysis,
- 4.10 Different computer statistical packages and their use in plant breeding.

5. Breeding self- pollinated crops by Introduction, Selection and Hybridization

- 5.1 Characteristics of self-pollinated crops
- 5.2 Crops introduction,
- 5.3 History and principles of selection,
- 5.4 Mass selection method,
- 5.5 Pureline selection method,
- 5.6 Objectives of hybridization,
 - 5.6.1 Pedigree selection method,
 - 5.6.2 Bulk selection method,
 - 5.6.3 Backcross selection method,
 - 5.6.4 Single seed descent method.

6. Breeding Cross-pollinated crops

- 6.1 Main characteristics of cross-pollinated crops,
- 6.2 Concept and theory of population improvement,
- 6.3 Mass selection method,
- 6.4 Progeny selection methods i.e. half-sib, full-sib, selfed progeny selection etc.
- 6.5 Recurrent selection method:
 - Simple recurrent selection,
 - Reciprocal recurrent selection,
 - Recurrent selection for combining abilities,
- 6.6 Types of varieties and their development,
- 6.7 Hybrid varieties development procedures and their seed production methods.

7. Special Techniques

- 7.1 Mutation breeding,
- 7.2 Polyploidy in plant breeding,
- 7.3 Apomixis,

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Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 7.4 Self incompatibility and its application in plant breeding,
- 7.5 Male sterility and its application in crop improvement,
- 7.6 Wide crossing and distant hybridization in plant breeding
- 7.7 Clonal breeding,
- 7.8 Breeding for resistance to biotic stresses i.e. diseases and insects,
- 7.9 Breeding for abiotic stresses i.e. drought, mineral heat and cold,
- 7.10 Breeding for quality improvement,
- 7.11 Ideotype concept in crop improvement,

8. Biotechnology

- 8.1 Scope and importance of plant biotechnology in Nepalese context,
- 8.2 Plant tissue culture,
- 8.3 Genetic engineering,
- 8.4 Embryo culture,
- 8.5 Anther or pollen culture,

- 8.6 Methods of gene transfer,
- 8.7 Molecular markers,
- 8.8 Utilization of gene of interest and gene transfer:
 - Haploid breeding,
 - Intergeneric and interspecific crosses,
 - Marker assisted selection,
 - Overcoming conventional breeding barriers
 - DNA finger printing
 - Characterization of plant genetic resources with biochemical/molecular techniques,
- 8.9 Recent advances related to crop improvement:
 - Transgenic plants (GMO's for crop improvements and quality),
 - Terminator genes,
 - Genomics,
 - Biopesticide,
 - Biofertilizer.

9. Variety Release and Seed Technology

- 9.1 Evaluation,
- 9.2 Multiplication trials,
- 9.3 Variety release process in Nepal,
- 9.4 Status of seed and seed industry in Nepal,
- 9.5 The Nepalese Seed Act (2045) its amendment and Seed Regulation,
- 9.6 Classes of quality seed,

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Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 9.7 Seed and field standard for quality seed,
- 9.8 Seed priming
- 9.9 Seed marketing.
- 9.10 Terminator seed

10. Achievements of Plant Breeding in Nepal

- 10.1 Findings from Plant Breeding,
- 10.2 Findings in Plant Genetic Resources,
- 10.3 Future vision in plant breeding and genetic resources.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Agronomy

1. General

- 1.1 History of agronomy research and development in Nepal,
- 1.2 Agriculture sector in the current Five Year Plan,
- 1.3 Agriculture Prospective Plan (APP) in Nepal,
- 1.4 Area, production and productivity of major crops,
- 1.5 Seed and fertilizer policies in Nepal,
- 1.6 Main constraints of agricultural research and extension in Nepal,
- 1.7 Prospect of agriculture development in Nepal.
- 1.8 Institutions involved in agronomy research and development in Nepal
- 1.9 Importance of low cost technology in major crop to compete in world market.

2. Weather and Crops

- 2.1 Climate-temperature, humidity, winds and wind pressure, rainfall, effective rainfall, sunshine hours, soil temperature and their effects on crops,
- 2.2 Agro-climatic zones, seasonal patterns and crops of Nepal,
- 2.3 Effects of droughts, floods, cold, frost, hailstones, and wind on crops and their prevention,
- 2.4 Meteorological services to agriculture.

3. Soil and Fertilizers

- 3.1 Soil definition, soil and sub-soil, importance of top soil and sub-soils,
- 3.2 Texture, structure, bulk density, soil profile, consistency of soil and their importance in agriculture,
- 3.3 Soil of Nepal and their classifications,
- 3.4 Soil moisture, surface tension, water holding capacity of soil, movement of water in soil, loss of water from soil and amount of water used by different crops,
- 3.5 Essential plant nutrients and their sources,
- 3.6 Functions of essential elements and their deficiency symptoms,
- 3.7 Chemical fertilizer, their composition, chemical formula and transformation from fertilizer to available nutrient forms,
- 3.8 Process of absorption of nutrient by plant and loss of plant nutrients from soil,
- 3.9 Determination of nutrient requirement of major crops and amount of major nutrient (N.P.K.) removed by different crops,
- 3.10 Soil pH, its measurement, liming materials available for correcting soil pH, reaction of liming materials when applied in soil,
- 3.11 Importance of organic matters, soil organic matter, nutrient content of different animal manures,

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 3.12 Recommended doses of nutrients to different crops in Nepal, method of application and times of application in various crops,
- 3.13 Soil organism, function of soil organism, processes of ammonification, nitrification, denitrification, nitrogen fixation and importance of azotobacter, clostridium, algae, phosphobacterium, nitrogen cycle and VAM (Vesicular-arbuscular mycorrhiza) in agriculture,
- 3.14 Green manure – benefit of green manure, green manuring, influence of green manure, desirable characteristics of green manure, plants 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,
- 3.15 Strategy of maintenance of soil fertility in hilly areas of Nepal.

4. Water Requirement in Crop Production

- 4.1 Sources of water and its utilization,
- 4.2 Irrigation status and potential in Nepal,
- 4.3 Quality of irrigation water, irrigation methods and techniques of irrigation,
- 4.4 Measurement of water used by plants,
- 4.5 Losses of water in different operations,
- 4.6 Water requirement for a specific crop and a set of cropping pattern,
- 4.7 Drainage management.

5. Land Resources and Tillage

- 5.1 Physiographic distribution and land systems of Nepal,
- 5.2 Land capability and irrigation suitability,
- 5.3 Land utilization,
- 5.4 Soil classifications and its relationship with tillage practices,
- 5.5 Tillage-Objective of tillage, significance of tillage,
- 5.6 Importance of tillage in crop production,
- 5.7 Zero tillage, minimum tillage and optimum tillage,
- 5.8 Condition of soil suitable for cultivation,
- 5.9 Terrace management and cultivation.

6. Farming Systems and Outreach Research

- 6.1 Introduction, system approach in agriculture and determinants of farming system,
- 6.2 Components of farming systems and pre-dominant cropping patterns in Nepal,
- 6.3 Social, economical and institutional aspects of farming system,
- 6.4 On-farms farming system research (FSR), its methodology, characteristics of FSR, framework of FSR, diagnostic methods (RRA, PRA, agro-ecosystem, analysis, and conventional survey).

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

7. Weeds and Weed Control

- 7.1 Classification of weeds, their effects on crop production and pattern of weed distribution in Nepal,
- 7.2 Common weeds found in major field crops,
- 7.3 Principles and methods of weed control
- 7.4 Herbicides - types of herbicides, herbicide formulation, their modes of action, effects of herbicides on plants, herbicides use in Nepal,
- 5.5 Weed control measures in major cereals, legumes, oilseed and industrial crops,
- 5.6 Economic of herbicides use and their adverse effects on environment.

8. Insects, Diseases and their Control

- 8.1 Principles of diseases and insects control,
- 8.2 Sources of disease and insect infestation,
- 8.3 Main diseases of major field crops and their control measures,
- 8.4 Main insects and pests of major field crops and their control measures,
- 8.5 Common fungicides and insecticides used in Nepal,
- 8.6 IPM, use of plant pesticides.
- 8.7 Responses of crop varieties released in Nepal to different diseases and insects,
- 8.8 Environment and chemical control of diseases and insects.

9. Crops and Crop Improvement

- 9.1 Definition, importance, history and achievements of plant breeding,
- 9.2 Genetic basis of plant breeding,
- 9.3 Genotypes and phenotypes,
- 9.4 Mode of reproduction in crop plants,
- 9.5 Classification of crops according to pollination,
- 9.6 Germplasm collection, evaluation and utilization,
- 9.7 Methods of crop improvement in field crops,
- 9.8 Method of hybridization in major field crops,
- 9.9 Varietal improvement procedure in Nepal,
- 9.10 Purity maintenance of crop varieties.

10. Crop production

Study on rice, wheat, maize, finger millet, barley, buckwheat, amaranths, lentil, soybean, chickpea, cowpea, pigeonpea, mungbean, rapeseed, mustard, groundnut, sugarcane, jute and cotton with respect to:

- a) Introduction,
- b) Origin and distribution,
- c) Botany,
- d) Morphology, growth stages and its phenology,

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- e) Climate and soil,
- f) Recommended varieties and pipe-line genotypes,
- g) Physiology: photosynthesis, respiration and transpiration,
- h) Cultural practices - land preparation, seed treatment, seed priming, planting methods (spacing), planting time, seed rate, planting (seeding) time, interculture, harvesting, drying, cleaning, transportation, storage,
- i) Weed and weed control: important weeds found, control measures, recommended herbicides and their use, method and time of application,
- j) Manures and fertilizers - recommended doses, method of application and time of application,
- k) Water management -requirement, time and frequency of water application, irrigation methods and drainage,
- l) Plant protection measures – causal agents, predisposing factors, symptoms, and control measures.
- m) Typical cropping calendar and cropping patterns in hills, mid-hills, terai and inner-terai of Nepal,
- n) Economics of crop production of major crops (rice, maize, wheat, sugarcane, tobacco, cotton, jute, potato, lentil) and their marketing.

11. Seed Technology

- 11.1 Seed formation, development and composition,
- 11.2 Physiology of seed,
- 11.3 Seed quality and its classes,
- 11.4 Principles and practices of seed production,
- 11.5 Seed testing principles,
- 11.6 Seed certification procedures and seed certification standards in major crop in Nepal,
- 11.7 Seed and fertilizer distributing agency and legislation in Nepal,

12. Statistics Methods

- 12.1 Concepts and fundamental parameters of statistics,
- 12.2 Estimate and control of error-replication, blocking and randomization,
- 12.3 Field plot techniques and data analysis,
- 12.4 Randomization, layout and analysis of variance of complete randomized design, randomized complete block design and latin square design,
- 12.5 Concept and use of lattice design-balanced lattice design and partially balance lattice,
- 12.6 Randomization, layout, analysis of variance, interaction of two factor experiment i.e., split plot design and strip-plot design.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 12.7 Three or more factorial design-split-split plot design and strip-split-plot design,
- 12.8 Comparison- pair comparison by least significant different (LSD) and Duncan's Multiple Range Test (DMRT), between-groups comparison, within group comparison, trend comparison and factorial comparison,
- 12.9 Regression and correlation-simple linear regression and correlation, multiple-linear regression and correlation, simple nonlinear regression, multiple nonlinear regression.
- 12.10 Importance and validity of statistics in agriculture,
- 12.11 Use of computer statistical packages in agronomy research.

13. Achievements of Agronomy Research in Nepal

- 13.1 Major areas of agronomy,
- 13.2 Main findings in each area,
- 13.3 Gaps in agronomy researches and developments,
- 13.4 Suggestions to strengthen agronomical works in Nepal.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Entomology

1. Introduction

- 1.1 History of entomology in Nepal
- 1.2 Definition of an insect
- 1.3 Relatives of insects and their relationships
- 1.4 Generalized external and internal organization patterns of a winged insect
- 1.5 Harmful and beneficial insects: nationally important insect pests of agriculture, pollinators including honey bees, silkworms, lac insects, entomophagus insects

2. External morphology of insects

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

3. Internal anatomy and physiology of insects

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

4. Insect ecology

- 4.1 Weather and climate: temperature, humidity, water, wind and light
- 4.2 Food: organic remains, plant material, animal material
- 4.3 Animal and plant community: competition, predation and parasitism
- 4.4 Habitat: Terrestrial habitats, fresh water habitats and marine habitats.
- 4.5 Symbiotic associations
- 4.6 Insect populations
- 4.7 Ecological methods
- 4.8 Life table

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

5. Insect toxicology

- 5.1 Synthetic chemical insecticides, acaricides and molluscicides, their classifications by hazard (WHO classification).
- 5.2 Classification of insecticides based on mode of entry, mode of action and chemical nature.
- 5.3 Botanical insecticides
- 5.4 Type of insecticide formulation
- 5.5 Commonly used insecticides in Nepal
- 5.6 Metabolite/s formation and degradation of insecticide in plants and animals
- 5.7 Mode of action of organophosphates and carbamates in target organism
- 5.8 Insecticide residues: maximum residue limit (MRL) and average daily intake (ADI)
- 5.9 Median lethal dose (LD 50) of insecticides
- 5.10 Bioassay of insecticide in laboratory
- 5.11 Methods of diluting insecticide to a recommendation level
- 5.12 Equipments for handling insecticides
- 5.13 Repercussion of insecticide misuse and overuse
- 5.14 Proper storage and disposal of insecticides
- 5.15 Precautions in handling insecticides

6. Principles of insect control

- 6.1 Cultural methods: use of resistant varieties, crop rotation, crop refuse
- 6.2 destruction, tillage of soil, variation of time of planting or harvesting, pruning or thinning, fertilization, sanitation, water management, planting of trap crops.
- 6.3 Mechanical methods: hand destruction, exclusion by screen, barriers.
- 6.4 Physical methods: heat, cold, humidity, energy and sound.
- 6.5 Biological methods: conservation of natural enemies, importation of exotic natural enemies of insect pests and augmentations of natural enemies, propagation and dissemination of specific bacterial, virus, fungus, and protozoan diseases.
- 6.6 Chemical methods: attractants, repellents, insecticides, sterilants and growth inhibitors
- 6.7 Genetic methods: propagation and release of sterile or genetically incompatible pests.
- 6.8 Regulatory methods: plant quarantine, eradication and suppression programs.
- 6.9 Integrated pest management (IPM)
- 6.10 Regulatory provisions of plant protection in Nepal.

7. Biological control

- 7.1 Scope, history and concepts
- 7.2 Biological characteristics of entomophagus insects

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 7.3 Foreign exploration for beneficial organisms and quarantine handling
- 7.4 Mass rearing of parasitoids, predators and their host insects
- 7.5 Methods of colonization, inoculation, augmentation, recovery of entomophagous insects and their evaluation with respect to efficacy to suppress target pest insect/s
- 7.6 Conservation of natural enemies of pest insects
- 7.7 Biological control of insect as a component of IPM
- 7.8 Microbial pathogens against pest insects
- 7.9 Biological control of weeds by insects

8. Insect taxonomy

- 8.1 Importance of taxonomy
- 8.2 Systematics and identification of insects belonging to different Orders
- 8.3 Species and subspecies of insects
- 8.4 Curating
- 8.5 Data recording
- 8.6 Practice of classification: use of literature, use of names, zoological nomenclature and descriptive taxonomic process
- 8.7 Publication of data
- 8.8 Methods of collection, preservation and dispatching insect specimens to specialist

9. Statistics in entomological research

- 9.1 Descriptive statistics
- 9.2 Chi-square test
- 9.3 Student t-test
- 9.4 Mortality correction
- 9.5 Transformation of data: square root transformation, logarithmic transformation and angular (arc sine) transformation.
- 9.6 Analysis of variation
- 9.7 Mean separation: LSD and Duncan's Multiple Range Test

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty – Food Technology

Food Technology

Basic principles of food preservation and their mode of development in the 21st century. Various kinds of packaging materials and their role in marketing of food products. Processing of foods-cereals, legumes, and oilseeds, fruits and vegetables, tea, coffee, and spices, confectionery, and bakery products, meat, and meat products, milk and milk products, eggs and poultry products, fishery products, sugar and chocolates, use of chemical additives in food preservation. Prediction of shelf life of food-stuffs, role of enzymes in food processing. Cold storage, cellar stores for extending shelf life of vegetables. Role of Refrigeration and Freezing in Storage of perishable commodities.

Food Engineering:

Unit operation in food processing, Material Balance and Energy Balance, Steam generation and utilization, Boiler operation and its maintenance, High Pressure Food Technology. Super critical fluid extraction and its uses in food industry. Food rheology and texturization. Dehydration of food, various kinds of dryers; such as cabinet, Tunnel, Drum, Spray, and Evaporators. etc.

Food Chemistry:

Food chemistry and its development. Proximate composition of foods, and their determination, chemistry of carbohydrates-monosaccharide, disaccharides, and polysaccharides, caramelization, Maillard reaction, and Browning reaction in food system, Lipids, fatty acids, and their role in identification of major edible oils such as Mustard/Rapeseed oil, olive oil, peanut oil, Soybean oil and sunflower oil, etc Basic concept of ADI limits of food additives and use of Additives.

Antioxidants, Emulsifying, and stabilizing agents, proteins, amino acids, flavoring substances, chelating agents, surface-active agents, cleaning agents, humectants, and anticaking agents etc, Food rheology.

Food Microbiology

Microorganisms and their role in food preservation, and processing. Microbiology and cytology of bacteria, yeasts, and molds, Basic principles of serology and immunology. Growth theory of microbes, Environmental food microbiology – air, water, and soil, Microbiology of meat and meat products, milk and milk products, fruits and vegetables. Food – borne infection and intoxication, HACCP, and its importance in food quality assurance, Biotoxins, GMOs, Food pathogens, and Indicator organisms, Listeria disteamonocytogens, Staphylococcus aureus, Clostridium botulinum, and Clostridium perfringens.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Human Nutrition:

Status of malnutrition and micronutrients deficiency in Nepal. Nutrition as a developmental indicator. Interface between agriculture, health and nutrition, Food-based dietary guidelines, Food composition tables, Growth monitoring for nutritional well being, Diets and their role in management of cardiovascular diseases, Improvement strategy for nutritional status of the Nepalese People, Nutritional requirements for infants, pregnant and lactating mother. Food fortification, Balanced diets, Role of vitamins and minerals in upliftment of nutrition of the people, Food security, PER, NPU, and BMI, Metabolism of carbohydrates, lipid, and protein.

Quality Control:

Basic elements of Food Quality Control, Salient feature of the Food Act 2023, and Food Regulations 2027, and subsequent amendments, critical views of the existing food legislation to comply with WTO regime. Good Agriculture Practices (GAP), Good manufacturing Practices (GMP). Good Hygienic Practices (GHP), and Good Veterinary Practices (GVP). and their relevance in food safety assurance, Status of food contaminants in Nepalese Context and their ramification strategy, HACCP, and Risk Analysis, Codex Standards and their implication in development countries.

Basic principle of food analysis, Instrumental analysis and their importance in identifying and detecting new emerging hazards; principles and use of GLC, HPLC, AAS in food analysis food inspection and sampling, food plant sanitation and hygiene, major food adulterants in Nepalese market. HMG's current plans, policy and strategy for enhancing consumer food safety, Laboratory Quality Assurance, Laboratory Accreditation and Proficiency Testing, Basic approach to develop a new analytical methodology.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Horticulture (Olericulture)

1. General

- 1.1. History, impact and importance of horticultural research and development plans and programs in Nepal.
- 1.2. Major constraints limiting production of horticultural crops in Nepal.
- 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 in Nepal.
- 1.7. Classification of horticultural plants.

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 gourd, bitter melon, pointed gourd, ridge 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. Off-season Vegetables Production

- 3.1. Present status, constraints and potentiality
- 3.2. Utilization of diverse agro-climatic zones for off-season vegetables production
- 3.3. Suitable crops, varieties and months for off-season production.
- 3.4. Protected cultivation:- Green house, lath house, plastic tunnel, hot beds, cold frame, etc.
- 3.5. Improved cultural and management technologies and practices for off-season production.
- 3.6. Cost and benefits of off-season vegetable production.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

4. Seed Production Technology:

- 4.1. Present status of vegetables seed production and marketing in Nepal.
- 4.2. High value with low volume vegetables crops and their production zones of the country.
- 4.3. Effects of location, aspects, altitude, temperature, light, daylight, spacing irrigation, manures, fertilizers, micro nutrients, hormone, direct seeding, stickling-transplanting, seeding and planting time on seed yield and seed quality.
- 4.4. Pollination, fertilization, seed development, dormancy and germination.
- 4.5. Technique of quality control in seed production.
- 4.6. Seed production methods for open pollinated and hybrid cultivars.
- 4.7. Existing vegetable seed production zones of Nepal.
- 4.8. Major problems and weakness of vegetable seed research, vegetable seed production and marketing in Nepal.
- 4.9. Pre-basic, basic improved/certified seed production in potato and ginger.
- 4.10. Breeder, nucleus and foundation seed production in vegetable.

5. Post-harvest technology of vegetables

- 5.1. Post-harvest physiology- respiration, transpiration and ethylene production.
- 5.2. Method of harvesting, cleaning, grading, and packaging.
- 5.3. Post harvest handling, transportation and marketing.
- 5.4. Consumer's acceptability and quality evaluation of vegetables.
- 5.5. Processing and preservation of vegetables, potato, ginger and cardamom.

6. Modern Technology of vegetable Production

- 6.1. Application of bio-technology and tissue culture in horticulture.
- 6.2. Used of plant growth regulators in vegetables
- 6.3. Drip and other micro irrigation.
- 6.4. ?
- 6.5. Micro-nutrient, multi-nutrient, liquid fertilizers and bio-fertilizers.
- 6.6. Latest recommended superior hybrid and superior open pollinated cultivars used by Nepali farmers.
- 6.7. Principles and methods of disease and pest control (with emphasis on integrated disease and pest management, sex lure and pheromone for trapping, biological organism, etc.)
- 6.8. Integrated soil and plant nutrient management.
- 6.9. True potato seed.
- 6.10. Disease free seed potato production.

7. Indigenous Technology

- 7.1. Local and wild edible vegetable, species, cultivars and their usefulness.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 7.2. Indigenous practices of vegetable cultivation.
- 7.3. Indigenous methods of disease and pest control and preventive measure.
- 7.4. Indigenous methods of soil fertility improvement and management.
- 7.5. Indigenous methods and management of water conservation and utilization.

8. Plant Genetics and Improvement

- 8.1. Genes and their action
- 8.2. Genotypes and phenotype
- 8.3. Homozygosis and heterozygosity
- 8.4. Improvement of variation
- 8.5. Breeding methods: self pollinated species, cross pollinated species,
- 8.6. Concept of heterosis and development of hybrid variety.
- 8.7. Mutation breeding
- 8.8. Genetic erosion and transformation.
- 8.9. Use of transgenic plants.

9. Vegetable Crop Physiology

- 9.1. Photosynthesis
- 9.2. Respiration
- 9.3. Transpiration and translocation
- 9.4. Growth and development: cell division, enlargement and differentiation.
- 9.5. Photoperiodism, light intensity and quality.
- 9.6. Stress physiology - temperature stresses, moisture stresses and nutrient stresses.

10. Research Methods and Management

- 10.1. Need of research in vegetable commodities.
- 10.2. Steps in research project proposal preparation.
- 10.3. Design of experiment
- 10.4. Exploratory research.
- 10.5. Academic research and adoption research.
- 10.6. Multi disciplinary and inter-disciplinary research
- 10.7. Laboratory research.
- 10.8. Multi-location research.
- 10.9. Outreach research
- 10.10. Farmer's participatory research.
- 10.11. Socioeconomics and market research
- 10.12. Collaborative research.
- 10.13. Multi-partnership research.
- 10.14. Data base preparation.
- 10.15. Data analysis, technical report writing and presentation.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

11. Biological Statistics

- 11.1. Need of biological statistics for research and researcher.
- 11.2. Probability, frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling theory, test of hypothesis, and confidence interval, T-test, F-Test and Chi-square test.
- 11.3. Estimate of error: - Replication and randomization.
- 11.4. Control error: - Blocking, proper plot technique and data analysis.
- 11.5. Control randomized design: - Randomization, layout and analysis of variance.
- 11.6. Randomized complete block design: - Layout, randomization, analysis of variance.
- 11.7. Latin square design:- Randomization, layout, analysis of variance and efficiency of row and column- blocking.
- 11.8. Incomplete block design:- Layout, randomization and analysis of variance.
- 11.9. Two or more factorial experiment-randomization, layout, analysis of variance and interaction.
- 11.10. Split plot design: - Randomization, analysis of variance and interaction of factors.
- 11.11. Comparison:- Pair comparison by Least Significant Different (LSD) and Duncan's Multiple Range Test (DMRT)
- 11.12. Regression and correlation:- Simple linear regression and correction, multiple-linear regression and correction.
- 11.13. Co-variance
- 11.14. Use of statistical tools in data analysis.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - 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
- f. 1. Physiographic distribution of Nepal
- g. 2. Land systems, land use and land capability
- h. Orchard establishment including site selection, lay out and planting of fruit plants
- i. Nursery management
 1. Propagating structure
 2. Media
 3. Fertilizers
 4. Soil mixtures
 5. Nursery bed preparation
 6. Stratification of seeds of different fruits
 7. Planting of grafted plants in the beds
- j. 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

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

stock on scions Different types of rootstocks, Different types of scions and their methods of collection and preservation for latter use.

Cuttings

Grafting

Budding

Layering

Propagation by Specialised stems and roots

Micro propagation

Tissue culture

- k. Cultural practices
 - l. 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
 - m. Training and pruning of the fruit trees
 - 1 Importance of pruning
 - 2 Different methods of pruning
 - 3 Effects of pruning on plant growth
 - n. Problems of Fruiting
 - o. Mango malformation
 - p. Citrus decline
 - q. 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

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- g. Cultural practices
- h. Weed control
- i. Manures and fertilizers
- j. Pests and diseases
- k. Harvesting 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 randomisation
- c) Layout 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
- q) Liming and liming materials
- r) Soil organic matters

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- s) C: N ratio
- t) Soil organism and their functions
- u) Green manuring
- v) Farm yard manure and compost
- w) 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

7. Growth regulation

- a. Photosynthesis, respiration and transpiration
- b. Growth of plants
- c. Polarity and differentiation
- d. 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

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- e. 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

- f. 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

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Plant Pathology

1. Introduction

- 1.1. Meaning and concept of plant pathology,
- 1.2. History of plant pathology,
- 1.3. Importance of plant pathology,
- 1.4. The nature and concept of plant diseases,
- 1.5. Causes of plant diseases,
- 1.6. Classification of plant diseases,
- 1.7. Symptom and signs produced by different plant pathogens, and other disease causing agents, and
- 1.8. Plant disease diagnosis and identification – Koch's postulate.

2. Plant pathogens and other plant disease causing agents

- 2.1. General characteristics (morphology, nutrition, reproduction), isolation, purification, taxonomy, nomenclature, classification of different fungi, bacteria, bacteria-like organisms, and mycoplasmas or mycoplasma like organisms,
- 2.2. General characteristics (morphology, nutrition, anatomy), isolation, taxonomy, nomenclature and classification of nematodes,
- 2.3. 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
- 2.4. Characteristics of non-infections plant disease-causing agents (Environments, nutrients, pollution, improper agricultural practices, etc.)

3. Parasitism and disease development

- 3.1. Parasitism and pathogenicity,
- 3.2. Host range of plant pathogens, and
- 3.3. Stages in development of diseases (Disease cycle):
 - 3.3.1. Inoculation,
 - 3.3.2. Penetration,
 - 3.3.3. Infection,
 - 3.3.4. Growth and reproduction (multiplication) of the pathogens,
 - 3.3.5. Dissemination (Dispersal) of the pathogens, and
 - 3.3.6. Pathogen survival (over-wintering/over-summering) of pathogens.

4. Mechanisms of infection by plant pathogens

- 4.1. Mechanical forces by pathogens,
- 4.2. Chemicals,

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 4.3. Enzymes,
 - 4.4. Toxins (host specific and nonspecific), and
 - 4.5. Growth regulations (Auxin, Gibberellins, Cytokinin, Ethylene, Polysaccharides etc.
- 5. Effects of plant pathogens on host physiology**
- 5.1. Effects on structure, growth and reproduction of the host,
 - 5.2. Effect on host photosynthesis,
 - 5.3. Effect on host respiration, and
 - 5.4. Effects on translocation of water and nutrients in the host plant.
- 6. Defense mechanisms of host plants to plant diseases**
- 6.1. Structural defense and
 - 6.2. Biochemical defenses.
- 7. Effects of environment on plant disease development**
- 7.1. Temperature,
 - 7.2. Moisture,
 - 7.3. Wind,
 - 7.4. Light,
 - 7.5. Soil pH,
 - 7.6. Host plant nutrition, and
 - 7.7. Other environmental factors.
- 8. Genetics and plant disease**
- 8.1. Genetics systems in plant pathogens,
 - 8.2. Genes and compatibility factors in plant pathogens,
 - 8.3. Mechanisms of pathogen variability,
 - 8.4. Host-pathogen interfaces,
 - 8.5. Gene for gene concepts,
 - 8.6. Nature of resistance, genetics of host resistance, tolerance, etc., and
 - 8.7. Breeding for disease resistance.
- 9. Plant disease epidemiology, disease forecasting and crop losses**
- 9.1. Development of plant disease epidemiology,
 - 9.2. Elements of plant disease epidemics: host, pathogen, environment, diseases, etc.
 - 9.3. Temporal and spatial analysis of epidemics: Infection rates and disease progress curves,
 - 9.4. Forecasting of plant diseases and their epidemics,
 - 9.5. Simulation models of plant diseases, and
 - 9.6. Plant disease measurement and crop loss assessment.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

10. Principles and methods of plant disease control

A. Principles:

- 10.A1. Avoidance of pathogens
- 10.A2. Exclusions of inoculum,
- 10.A3. Eradication of pathogens,
- 10.A4. Immunization,
- 10.A5. Protection measures, and
- 10.A6. Therapy

B. Methods

- 10.B1. Regulatory method,
- 10.B2. Cultural method,
- 10.B3. Biological method,
- 10.B4. Physical method,
- 10.B5. Chemical (Pesticides) method,
- 10.B6. Host resistance, and
- 10.B7. Integrated disease management.

11. Pesticides in plant disease control

- 11.1. History, classification and nomenclature of pesticides,
- 11.2. Major pesticides and their formulations,
- 11.3. Evaluation of pesticides in the field and the laboratory,
- 11.4. Mode of action, compatibility and phytotoxicity of pesticides,
- 11.5. Application methods of pesticides,
- 11.6. Appropriate pesticide application equipments and auxiliary spray materials,
- 11.7. Factors affecting the field performance of pesticides,
- 11.8. Safe storage and handling of pesticides, and
- 11.9. Antidotes and other precautionary measures while handling pesticides.

12. Laboratory equipments and chemicals used in plant pathology

- 12.1. General and specific equipments and machineries used in plant pathology,
- 12.2. General and specific glass-wares used in plant pathology,
- 12.3. General and specific media to grow fungi, bacteria and other plant pathogens, and
- 12.4. Common and specific cleaning, sterilizing, preserving, fixing, staining and other chemicals used in plant pathology.

13. Laboratory and field techniques in plant pathology

- 13.1. Survey, collection of disease specimens and methods of disease recording,
- 13.2. Disease specimen preservation and cataloguing,

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 13.2. Dis-infection, sterilization, culturing, maintenance and other lab-techniques in plant pathological studies, and
- 13.4. General disease diagnosis techniques.

14. Economic importance, distribution, disease symptoms, causal agents, disease cycle, predisposing factors of disease developments and adopted control measures of nationally important diseases of major crop plants caused by
 - 14.1. Fungi,
 - 14.2. Bacteria, Bacteria, like organisms and Protozoa,
 - 14.3. Viruses, Viroids, Mycoplasmas and Mycoplasma like organisms,
 - 14.4. Nematodes,
 - 14.5. Phanerogamic parasites or higher parasitic plants, and
 - 14.6. Environmental factors and physiological disorder

15. Seed pathology
 - 15.1. Seed borne diseases and their significance and
 - 15.2. Seed health testing for fungi, bacteria, viruses and nematodes.

16. Storage fungi and mycotoxins
 - 16.1. Mycotoxigenic fungi,
 - 16.2. Major classes of mycotoxins, and
 - 16.3. Mycotoxin in human beings and animals (mycotoxicoses)

17. Mushroom
 - 17.1. Survey, collection, identification and preservation of mushroom species,
 - 17.2. Spawn production techniques, and
 - 17.3. Cultivation techniques of common edible (*Agaricus* and *Pleurotus*) mushrooms.

18. Mycorrhiza and their uses in plant pathology

19. Bio-technology in plant pathology
 - 19.1. Importance of tissue culture techniques in Plant Pathology,
 - 19.2. Use of molecular techniques in characterization of plant pathogens and host plants for resistance to diseases, and
 - 19.3. Other uses of biotechnology in plant pathology.

20. Statistics in plant pathology
General knowledge of statistical tests, designs, and other techniques to draw inferences for the collected data of plant pathological origins.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

21. Project proposal development for plant pathological researches
Major items or contents needed for the development of a sound project document based on NARC project format.

22. General knowledge of Nepal Agricultural Research Council
Its organizations, roles, objectives, importance, major activities, and linkages with other agricultural and non-agricultural sectors of the country.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Soil Science

1. Soil Fertility and Plant Nutrient Management:

- 1.1 Concept of soil productivity and fertility
- 1.2 Essential plant nutrients and their classification
- 1.3 Nutrients availability and plant growth influences by soil pH, clay particles, organic matter, Cation exchange capacity, soil depth, surface slope, texture, structure, evaluation of soil fertility by missing element techniques, field experiment, soil and plant analysis
- 1.4 Nutrients availability, plant uptake, plant response, deficiency symptoms of crops and indicator plants
- 1.5 Different forms of nutrients taken up by plants and loss of nutrients from soil, importance of balance fertilizer, application methods and appropriate time
- 1.6 Diagnostic technique and fertilizer recommendation
- 1.7 Fertilizer use efficiency and factor affecting plant growth
- 1.8 Concept and prospect of "Integrated Plant Nutrients System (IPNS)"
- 1.9 Indigenous soil fertility management systems in Nepal

1.2 Manure and Fertilizers

- 1.2.1 Sources and types of manures, commercial fertilizers and their uses
- 1.2.2 Method of FYM and compost preparation, application methods of FYM and compost
- 1.2.3 The nutrients composition of manure
- 1.2.4 Chemical fertilizers and its importance
- 1.2.5 Type of fertilizers, nutrients content and fertilizer handling and storage
- 1.2.6 Crop response of fertilizer and fertilizer recommendation for major crops of Nepal

2. Soil Microbiology/Biology:

- 2.1 General classification of soil organisms, role of bacteria, fungi, algae, actinomycetes, protozoa and virus
- 2.2 Optimum condition for essential microbial activity in soil, encouraging beneficial microorganisms, composting and crop residue management
- 2.3 C.N. ratio-its important in decomposition and relationship between high C. N. ratio low C.N. ratio
- 2.4 Role of biogas in rural development and soil productivity
- 2.5 Biofertilizers- nitrogen fixers, Azolla, phosphate-solublizing microbes, vesiculararbusucularmycorrhizes (VAM), plant growth promoting Rhizobacteria (PGPR) and sulfur solublizing microbes.
- 2.6 Strain selection, collection, evaluation, propagation, inoculants preparation and response to inoculation in Nepal

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 2.7 Significant of inoculants in agriculture
- 2.8 Importance of "biological nitrogen fixation" (BNF) in agriculture and use of nitrogen fixing plants
- 2.9 Green manure- benefit of green manure, 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
- 2.10 Use of indigenous plant materials as nutrient source for crop production in different parts of Nepal

3. Soil Chemistry

- 3.1 Kind of exchangeable ion and exchange capacity
- 3.2 Mineralization and immobilization of nitrogen, nitrification, denitrification and nitrogen losses from the soil system and the nitrogen cycle
- 3.3 The phosphorus cycle and transformation, managing soil phosphorus
- 3.4 The potassium cycle, soil potassium, different forms of potassium
- 3.5 Role of sulfur, calcium, magnesium, sources and requirement in crop production
- 3.6 The sulfur cycle, soil sulfur, some characteristic of soil sulfur and amendments
- 3.7 General concept of micronutrients (Boron, Copper, Iron, Manganese, Molybdenum, Zinc, Chloride) role, sources, availability, functions, deficiency symptoms and application
- 3.8 Micronutrients that are low availability in Nepalese soils.
- 3.9 Soil pH- definition, role of soil pH on nutrients availability, soil pH correction, and reaction of liming material when applied in soil

4. Soil and Plant Analysis:

4.1 Soil Analysis

- 4.1.1 Soil sampling techniques- soil profile sampling, soil sampling of establish experimental plots, sampling from fields
- 4.1.2 Soil samples preparation and properly handling of soil samples in the laboratory

4.2 Soil test correlation and interpretation and soil test critical limitation for various nutrients

- 4.2.1 Fertilizer recommendation on the basis of soil test

5. Plant Analysis

- 5.1 Importance of plant analysis
- 5.2 Plant samples collection and preparation
- 5.3 Plant analysis for various nutrients
- 5.4 Plant analysis as a diagnostic tool

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

6. Soil Physics:

- 6.1 Particles density, bulk density, porosity, particles size and chemical natures
- 6.2 Soil texture classification and behavior of different soil textures
- 6.3 Soil structure- definition, types and classes of soil structure, organic matter effect and agriculture significance
- 6.4 The dynamic properties of soils- consistency, plasticity, shear strength, compaction and resistance to penetration of soil
- 6.5 Soil color and aeration and
- 6.6 Thermal regime of soils- thermal properties of soil
- 6.7 Soil water-the field water balance, water movement, infiltration, percolation and permeability
- 6.8 Importance of soil drainage in agriculture

7. Soil Physical Measurement:

- 7.1 Determination of soil texture by field method
- 7.2 Hydraulic conductivity measurement in situ
- 7.3 Bulk density- Core method
- 7.4 Infiltration measurement
- 7.5 Soil aggregate analysis

8. Soil Genesis, Classification and Mapping:

- 8.1 Concept of soils, Definition
- 8.2 Weathering and soil formation
 - 8.2.1 Rocks and minerals (Parent materials)
 - 8.2.2 Soil forming minerals
 - 8.2.3 Weathering and soil forming processes
 - 8.2.4 Factors of soil formation
 - 8.2.5 Soil profile and soil horizons development
 - 8.2.6 Diagnose horizons for classification-epipedons, subsurface diagnostichorizons, diagnostic organic materials and diagnostic soil characteristic

9. Soil Survey

- 9.1 Important and purpose of soil survey
- 9.2 Type and methods of soil survey
- 9.3 Identification of soil profile and description
- 9.4 Base maps and soil mapping
- 9.5 Types of soil maps and their important

10. Soil Classification

- 10.1 General concept and importance of soil classification USDA system

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

10.2 Soil taxonomy-USDA systems

11. Soil and Water Conservation:

- 11.1 General concept and principal
- 11.2 Type of soil erosion
- 11.3 Mechanics of wind erosion and controlling measures
- 11.4 Land capability classification to prevent soil erosion
- 11.5 Terracing, strip-cropping, cover crops
- 11.6 Soil depleting, conserving and building crops
- 11.7 Conservation irrigation and farm drainage management

12. Statistics

- 12.1 Elements of experimentation, complete randomized design-randomization, layout and analysis of variance
 - 12.1.1 Randomized complete block design-layout, randomization, and analysis of variance.
- 12.2 Latin square design-randomization, layout, analysis of variance, efficiency of row and column-blocking of variance, efficiency of row column-blocking and lattice design-balance lattice designs partially balance lattice.
- 12.3 Two factorial experiment randomization, layout analysis of variance, interaction.
- 12.4 Split-plot design-randomization, analysis of variance.
- 12.5 Three or more factorial design-split-split plot design, two or three factorial design, strip-split-plot design.
- 12.6 Comparison-pair comparison by least significant deferent (LSD) and Duncan's Multiple Range Test (DMRT), group comparison-between-group comparison, within group comparison, trend comparison and factorial comparison.
- 12.7 Regression and correlation- simple linear regression and correlation, multiple-linear regression and correlation, simple non-linear regression, multiple nonlinear regressions.
- 12.8 Farmer's field as the test site
- 12.9 Importance and validity of statistical in agriculture.

13. General

- 13.1 Nepal Agricultural Research Council: establishment, objective, role and activities.
- 13.2 Agriculture in recent five-year plan in Nepal.
- 13.3 Present agricultural issues in different agro-ecological zones of Nepal.
- 13.4 Fertilizer distribution sources and government policy in Nepal,
- 13.5 Nepal Agricultural Research Council (NARC) guidelines and directives for sustainable agricultural development in Nepal, 2003 AD.
- 13.6 Main constraints for agricultural research and agricultural productivity in Nepal.
- 13.7 Future scopes and strategies of advance agriculture research in Nepal.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Soil Science (GIS & Cartography)

1. Geographical Information Systems

- 1.1 Introduction
- 1.2 Computer-assisted mapping and map analysis
- 1.3 Components of a geographical information system
- 1.4 GIS for Decision making
- 1.5 Applications of GIS
- 1.6 Functional Components of GIS

2. Database Concepts and Design

- 2.1 Databases as Representation of Reality
- 2.2 Database Management System (DBMS)
- 2.3 Components of DBMS
- 2.4 Database Design
- 2.5 Spatial Data Model
- 2.6 Raster and Vector data structures (models)
- 2.7 Advantages & Disadvantages of Raster and Vector data structures
- 2.8 Consistency in Geo-database
- 2.9 Data compression
- 2.10 Metadata, Data Dictionary

3. Data Input, Verification, Storage, Output

- 3.1 Input devices
- 3.2 Map digitizing
- 3.3 Data sources (maps, digital, remote sensing, GPS)
- 3.4 Data verification, Data editing, updating cartography
- 3.5 Data Storage
- 3.6 Error detection / editing
- 3.7 Geo-referencing and Projections, Type & properties of map projection,
- 3.8 Data output
- 3.9 Output Devices, Software

4. Digital elevation models

- 4.1 The need for DEMs
- 4.2 Representing DEMs
- 4.3 Data registration and Geo-coding

5. Elementary Analysis Operations

- 5.1 Database exploration / updates
- 5.2 Database links / query / selection

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

5.3 Measurements (distance, area, shape)

6. Classification

6.1 Recoding / reclassification

6.2 Neighborhood functions

6.3 Buffer operations

7. Remote Sensing

7.1 Introduction

7.2 Energy Sources and Radiation principles

7.3 Sensor systems

7.4 Electro-Optical Scanners

7.5 Landsat

7.6 Spot, NOAA, Landsat, IRS, GOES

7.7 Microwave

7.8 Digital Image Processing

7.9 Image Interpretation, Classification

8. Cartography

8.1 Definition

8.2 Methods in Cartography

8.3 Map outputs

8.4 Map Scale

9. Global Positioning Systems

9.1 Introduction

9.2 Characteristics of GPS Satellite

9.3 Three Segments of GPS

9.4 GPS Applications

9.5 Parameters affecting the accuracy of results

10. Overview of Current GIS Packages

10.1 Introduction

10.2 Arc/Info GIS Software

10.3 ILWIS

10.4 IDRISI

10.5 ArcView

10.6 Grass

10.7 Other GIS Packages

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Biostatistics

Part I: General Information on Agriculture Statistics

1. Agriculture Development Strategy
2. NARC, NARC Vision, Laws, Bylaws and Organogram
3. Agriculture and statistical related policy and strategy
4. Agriculture research and development: History, achievements, constraints and scope
5. Agricultural statistics and trend analysis
6. National agriculture sample census 2011
7. Statistics and biometrics
8. Role of biometrics in agriculture innovation system
9. Basic concepts of statistics
10. Observations/ variables
11. Population and sample
12. Statistical system in Nepal and databases
13. Computer software

Part II: Technical Subject

1. Descriptive statistics

- 1.1. Frequency distribution
- 1.2. Measures of central tendency
- 1.3. Measures of variation and dispersion

2. Probability and distribution

- 2.1. Binomial distribution
- 2.2. Normal distribution
- 2.3. Poisson distribution
- 2.4. Chi-square distribution
- 2.5. Student's t distribution
- 2.6. Estimation and inference

3. Sampling

- 3.1. Sampling design
- 3.2. Sampling fundamental

4. Testing of hypothesis

- 4.1. Hypothesis
- 4.2. Hypothesis testing
- 4.3. Test of hypothesis
- 4.4. Important parametric test
- 4.5. Limitation

5. Analysis of categorical data

- 5.1. Contingency tables
- 5.2. Chi-square distribution

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

6. Non-parametric test

- 6.1. Chi-square test
- 6.2. Sign test
- 6.3. Wilcoxon's signed rank test
- 6.4. Rank correlation
- 6.5. Kolmogorov Smirnov one and two sample test
- 6.6. Wilcoxon Mann Whitney two sample test
- 6.7. Kruskal Wallis k-sample test
- 6.8. Friedman's test for two-way classification

7. Correlation

- 7.1. Simple linear correlation
- 7.2. Multiple linear correlation
- 7.3. Partial correlation
- 7.4. Test of hypothesis

8. Regression

- 8.1. Simple linear regression
- 8.2. Multiple linear regression
- 8.3. Non-linear regression (simple and multiple)
- 8.4. Test of hypothesis
- 8.5. Application of dummy variable
- 8.6. Searching for the best regression
- 8.7. Assumption and problem data
- 8.8. Use and misuse of correlation and regression analyses

9. Experimental design

- 9.1. Basic concepts of statistical models and use of samples
- 9.2. Concepts of experimental design, factorial experiments, confounded factorials
- 9.3. Principles and techniques of planning, establishing and executing field and greenhouse experiments
- 9.4. Completely randomized design
- 9.5. Randomized complete block design
- 9.6. Latin square design
- 9.7. Lattice design
- 9.8. Factorial experiments
- 9.9. Split-plot design
- 9.10. Strip plot design
- 9.11. Split-split plot design
- 9.12. Fractional factorial design
- 9.13. Confounded factorials
- 9.14. Change-over design
- 9.15. Incomplete block designs
- 9.16. Perennial crop experiment
- 9.17. Lab experiment
- 9.18. Livestock and fishery experiment
- 9.19. Experiment in farmers' fields
- 9.20. Assumption and data transformation
- 9.21. Missing values

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

10. Multi-observation data

- 10.1. Combining data from a series of years and/or locations
- 10.2. Rotation experiments
- 10.3. Repeated measures data

11. Covariance

- 11.1. Uses
- 11.2. Model and assumption
- 11.3. Computation

12. Means comparisons

- 12.1. Pair comparison
- 12.2. Group comparison

13. Multivariate analysis

- 13.1. An introduction to use of multivariate statistical methods
- 13.2. Applications of maximum likelihood estimation
- 13.3. Multivariate linear regression models
- 13.4. Cluster analysis
- 13.5. Discriminant analysis
- 13.6. Principal components analysis
- 13.7. Canonical correlation analysis

14. Special application of statistics

- 14.1. Bioinformatics and biotechnology
- 14.2. Statistics in genetics and plant breeding
- 14.3. Statistics in livestock and fishery breeding and their performance evaluation
- 14.4. Statistics in social science
- 14.5. Statistics in fruit crop breeding and their performance evaluation
- 14.6. Crop, livestock and fishery modeling

15. Biometrical software (SAS, SPSS, R, GIS, MSTATC, MINITAB, GenStat, MS Excel, etc)

16. Research Materials, Methods, Methodology and Design

17. Experimental plot/ unit technique

- 17.1. Size, shape and orientation of plots
- 17.2. Border and competition effects
- 17.3. Soil heterogeneity
- 17.4. Estimation of size of experiments for specified accuracy
- 17.5. Sub-sampling plots and yields for laboratory analysis

18. Interpretation and report writing

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty-Agro-Meteorology

Part I: General Information on Agro-meteorology

14. Agriculture Development Strategy
15. NARC: Laws, Bylaws, Organization and Vision
16. Agriculture research and development: History, achievements, constraints and scope
17. National Policy on Climate Change
18. Meteorology: Composition of the atmosphere, Weather elements, Precipitation, Temperature, Relative humidity, Wind, Sunshine, Global radiation, Dew
19. Climatology : Definition and scope of climatology, Climatic classification of Nepal: Thornwaite and Koppen's classification, Monsoon and annual rainfall, El Neno& La Nina Phenomenon
20. Agro Meteorology: Agro-Meteorology & its Scope, Interdisciplinary Aspects, Study the Practica, Utility on Agro-Meteorology, Future Thrust of Agro-Meteorology
21. Area, yield and production trend of following crops/commodities in Nepal:
 - Paddy, wheat, maize, potato, citrus fruits, vegetables , fisheries, Poultry
22. Climate Change: Definition and scope, Atmospheric composition and its changes, Green house effects and anthropogenic influences, Variation of climate in Nepal, Adaptation and mitigation.

Part II: Technical Subject:

1. Solar Radiation
 - Energy for Physical and Biological Processor occurring on the Earth Radiation received from Sun
 - Solar Constant and its measurement.
 - Measurement of Radiation Distribution in a Plant Canopy
 - Efficiency of Solar Radiation and its utilization.
 - Radiation and duration of sunshine
 - Distribution of solar radiation
 - Outgoing radiation
 - Radiation balance in the green house
 - Radiation utilization by field crops
 - Radiation utilization during successive stage of crop development
 - Empirical relationship between Radiation and crop yield
 - Efficiency of radiation utilization by field crop
2. Temperature and Photosynthesis
 - General effect of Radiation on plant growth
 - Respiration and net photosynthesis
 - Basic process of Photosynthesis
 - Photosynthesis in relation to temperature
 - Factor affecting the rate of net photosynthesis

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- Limiting Temperature for Net Photosynthesis
 - Photosynthesis in relation to Carbon Dioxide Concentration
 - Water in relation to Photosynthesis
 - The effect of water on photosynthesis
3. Physical properties of soil
- Soil texture its importance for plant growth
 - Particle and bulk density of soil
 - Soil structure its importance for plant growth
 - Improvement of soil texture
 - Effective soil depth
 - Soil temperature and crop yield
4. Air Temperature
- Sensible Heat Flux and Air Temperature
 - Heat Transfer from Plant Leaves
 - High temperature plant injury
 - Wind profile near the ground
5. Moisture factor in plant growth
- Soil Moisture
 - Absorption of water by Plants
 - Water flow in plants
 - Significance of soil temperature
 - The damage in effect of freezing temperature
6. Drought
- Definition of drought
 - Drought and its Classification
7. Water Loss and its Measurement
- Evaporation
 - Measurement of Evaporation by different methods
 - Transpiration
8. Evaporation versus Transpiration
- Difference between evaporation and transpiration
 - Evaporation from bare soil
 - Evapotranspiration
 - Relation between evapotranspiration and pan evaporation
 - Meteorological factors determining potential evapotranspiration
 - Estimation of evapotranspiration by BlaneyCriddle method
 - The effect of plant height on the rate of evapotranspiration

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 9 Lysimeter
 - Installation of Lysimeter
 - Drainage Sysimeter
 - Weighing Lysimeter

10. Effect of rainfall on plant growth
 - Weather forecasting for Agriculture
 - Accurate weather forecasting can reduce crop losses
 - Time factor in weather forecast
 - Types of weather forecasting and their application in Agriculture operation and planning
 - Preparation of weather outlook for the Farmers
 - Meteorological Basis of disease and insect pest present

12. Water yield crop relationship
 - Irrigation practice for maximum yield
 - Relation between actual evapotranspiration and yield

- 13 Agroclimatological management
 - Role of meteorological conditions in the formation crop
 - Weather and climate role in scheduling of sowing of crop
 - Role of weather and climate with cereal, vegetable and fruit crops

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Biometry

Part I. Statistical Theory and Methods

Probability

Definitions of Probability. Sampling with and without replacement. Joint probability, marginal and conditional probability, independence. Laws of probability. Bayes' Theorem.

Distribution theory

Random variables. Discrete and continuous random variables. The probability density function. Cumulative distribution function.

Expectation of functions of a random variable. Mean and Variance.

Standard distributions and their use in modelling, including Binomial, Geometric, Poisson, Negative binomial, Discrete uniform, Normal, Exponential, Gamma, Beta, Weibull, Cauchy, Lognormal.

Joint, marginal and conditional distributions. Independence. Covariance, correlation and partial correlation. The multivariate Normal and Multinomial distributions.

Probability generating function. Moment generating function. Applications of generating functions. Distribution of sums of random variables, and of sample mean. Central limit theorem.

The z, t, Chi-squared and F distributions, and their use as sampling distributions, including definitions in terms of $N(0,1)$ random variables.

Part II. Applied Statistics

General linear model

Least squares. Models for simple and multiple regression and for analysis of variance and covariance. Estimation of variance. Interval estimates of parameters. Importance of assumptions. Transformation of variables. Linearizing other models, e.g. multiplicative models and growth curves.

Proof of standard results for multiple regression (matrix notation).

Analysis of Variance (ANOVA) and Regression analysis

Analysis of variance for cross-classifications, with replication. Fixed and random effects; variance components. Nested forms. Application to data collected in experiments or by sampling.

Estimation of variance components.

Multiple regression: choice of variables, regression diagnostics, analysis of residuals, serial correlation in time series. Use of indicator variables. Detection of influential observations.

Linear Covariate Analysis. Various situations where they are used and interpretations.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Nonparametric methods

Nonparametric statistics. Situations where they are appropriate.
Data types. Scales of measurement.

Binomial test, Chi-square tests (one-way and two-way), Fisher's Exact test, Cochran Q test.

Kolmogorov-Smirnov test, Wilcoxon Signed Ranks test, Median test, Friedman Two-way ANOVA, Kruskal-Wallis One-way ANOVA, Spearman Rank Correlation, Kendall Coefficient of Concordance.

Multivariate methods

Multivariate population: Location vector, Dispersion matrix and Multivariate normal distribution. Bivariate and Multivariate analysis of variance. Biplot or AMMI analysis. Principal components analysis. Cluster analysis: Distance or similarity measures and linkage methods used in the classification. Discriminant analysis: calculation of discriminant function and probability of misclassification.

Part III. Design and Analysis of Experiments and Surveys.

Design and Analysis of Experiments

Randomization, replication, blocking. Factorial treatment structure. Confounding, partial confounding and fractional replication in 2^n experiments. Rectangular and Square Lattices. Balanced incomplete blocks.

Analysis of completely randomized experiments, randomized complete blocks, Latin squares, factorial designs, balanced incomplete blocks. General linear contrasts among treatments. Assumptions of linear model analysis. Analysis of residuals. Transformations. Missing values and methods of estimation.

Analysis of variance appropriate for each design.

Partition of sums of squares. Single degree of freedom contrasts.

Significance tests and confidence intervals for treatment means and contrasts. Interpretation of results. Robustness of analysis of variance to non-Normality, non-constant variance etc.

Design and Analysis of Surveys

Sample Survey Design. Description of Population or Sampling frame. Determination of Sample size. Design Effects. Simple Random Sampling. Multistage Sampling. Strata. Clusters. PPS Sampling.

Computing Variances from multistage sampling designs. Jackknife and Bootstrap methods and where they might be of use.

Design of Questionnaires. Methods of coding responses. Data entry and validation.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Part IV. Computer Use

General Knowledge and Maintenance Skill

Handling and Care of commonly used Hardware. General idea about Components – Processor Type, Memory, Hard disk, etc.

System Maintenance – use of Antivirus, Diskscan, Defrag, Rescue, etc.

Software Use

Installation and Uninstallation of Software. Knowledge of use of a TEXT EDITOR e.g. DOS EDIT or NOTEPAD. Experience with Word Processor, Spreadsheet and Database Packages.

Computing

Skill in the use of QBasic or any OTHER Programming Language.

Skill in the use of any one commonly available Statistical Analysis Package and Script (Macro) handling.

Simulation

System Simulations. Various methods and their applications.

Generation of uniform pseudo-random numbers; testing for uniformity.

Methods of generating random numbers from common distributions. Methods for Binomial, and Normal.

The End

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty – Biotechnology

- 1. Tissue Culture:**
 - a) History
 - b) Micropropagation
 - c) Somatic embryogenesis
 - d) Virus and pathogen elimination
 - e) Haploid production by anther and ovary culture
 - f) Embryo rescue
 - g) Ploidy manipulation
 - h) Germplasm conservation, storage and transportation (invitro, exsitu conservation and cryopreservation)
 - i) Production of secondary metabolites by cultured cells
 - j) Callus culture
 - k) Suspension culture
 - l) Variability and instability in tissue culture (Somaclonal variation)

- 2. Molecular biology:**
 - a) Organization of plant genes, repetitive DNA
 - b) Restriction enzymes
 - c) Functional genes (Encoding RNA molecules, Proteins)
 - d) Gene/s isolation and identification (cDNA, Genomic Library, Transposons)
 - e) Cloning strategy (Plasmid, Cosmid, Bacteriophage etc.)
 - f) Regulation of gene expression
 - g) DNA methylation
 - h) Antisense RNA
 - i) Mutagenesis

- 3. Cell biology:**
 - a) Isolation, culture and plant regeneration from protoplast
 - b) Protoplast fusion
 - c) Gene transfer into plant cells (Agrobacterium mediated, direct gene transfer)

- 4. Methodologies and techniques:**
 - a) PCR techniques (RAPD, Microsatellite, AFLP)
 - b) RFLP
 - c) Agarose gel, starch gel and SDS-PAGE electrophoresis
 - d) DNA sequencing
 - e) Preparation of media, buffer and reagents for tissue culture and DNA analysis
 - f) DNA and isozyme extraction, isozyme staining
 - g) Genetic analysis using computer software (MSTAT, GenSTAT, NTSys)

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination
Sub Faculty - Veterinary

Anatomy, Histology and Embryology

- Anatomical description of the organs of skeletal system of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of articular system and muscular system of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of digestive system of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of respiratory system of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of urogenital system of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of cardiovascular system of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of genital system of male and female cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of nervous system of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Anatomical description of the organs of sense organs and common integuments of cattle, buffalo, horses, sheep, goats, dogs, cats, pigs and poultry
- Introduction to histology and histological techniques
- Cytology, cell structure, cell division and study of basic tissues of the body
- Systemic histology - Histology of the organs of digestive, respiratory, urinary, reproductive, nervous, cardiovascular systems, sense organs, endocrine organs, lymphoid organs of domestic animals and birds.
- General Embryology - Introduction, gametogenesis, fertilization, development of foetus and foetal membranes in mammals and birds, Placentation and placenta in mammals
- Systemic Embryology- Development of organs of digestive, respiratory, urogenital, cardiovascular, nervous and locomotory systems and organs of special sense and endocrines. Stagewise study of embryo/foetus of chick, cattle/buffalo, sheep, goats, pigs, cats, dogs and horses.

Physiology:

- Structure of different types of muscles, mechanism of contraction and effect of different stimuli on contraction
- Chemical composition and physiological properties of muscle
- Rigor mortis, fatigue and chemical changes associated with muscular contraction
- General function of blood, blood cells, plasma and serum
- Blood cells, their functions and their role in body functions

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- Physiology and hemodynamics of blood circulation
- Blood pressure and the factors influencing it, venous pressure and arterial pulse
- Neural and chemical control of blood vessels and vasomotor reflexes
- Shock and its mechanism and classification; fluid and electrolyte balance
- Mechanism of respiration, chemistry of respiration, composition of inspired and expired air, blood gases and law of solubility of gases, transport of blood gases and exchange of gases in lungs and tissues
- Regulation of respiration, chemical regulation of respiratory centre
- Respiratory reflexes, role of respiration in acid base mechanism
- Respiration in birds
- Physiology of digestion- ingestion, mastication, movement of stomach, intestine, rumination and defecation and other digestive processes
- Thirst, hunger, vomition and eructation reflexes
- Composition, regulation and functions of saliva, pancreatic juice, bile, intestinal juice.
- Digestion in ruminant stomach- microbial activities in the stomach and intestines, absorption of foodstuffs, place of absorption, mechanism of absorption of carbohydrate, proteins, fats and water
- Digestion in chickens
- Physiology of excretion- mechanism of urine formation, micturition, physical characteristics and composition of urine in health and diseases, role of kidneys in acid, base and electrolyte balance, excretion of urine in birds
- Maintenance of body temperature, thermoregulation against cooling and heating
- Physiology of reproduction- sex organs and their functions in male and female animals, sex hormones and their physiological role in reproductive functions of male and female animals, oestrus, ovulation, fertilization and development of fetus, and parturition.
- Physiology of egg laying in birds
- Hormones and their general functions, mechanism of secretion, storage, transport, action, and regulation of secretion and recent approaches on the use of hormones in veterinary practices.
- Chemical nature, secretion, functions and regulation of secretion of hormones from hypothalamus, pituitary, thyroid, pancreas, adrenal and male and female reproductive organs.
- Physiology of nervous system- degeneration and regeneration of nerve fibres, nature of nerve impulse and its propagation, cutaneous receptor organs, peripheral nerves, spinal cord and reflex action, autonomic nervous system
- Sensary organs and their function and mechanism of vision, hearing, taste and olfaction
- Examination of proper functioning of different organs of excretion and reproduction.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Biochemistry/biotechnology:

- Scope and importance of biochemistry, biochemistry of cell and cell organelles
- Physical biochemistry-concentration of solutions, diffusion, osmotic pressure, dissociation of acids, pH, buffer system
- Biochemistry of carbohydrates, lipids, proteins
- Enzymes-definition, properties, composition, specific enzyme action, enzymes and coenzymes involved in oxidation and reduction
- Metabolism in ruminants and non ruminants-Carbohydrate metabolism-glycolysis, TCA cycle; fat metabolism-beta oxidation of fatty acid, ketone body formation; protein metabolism-deamination and transamination, urea synthesis, protein synthesis; nucleic acid metabolism-DNA synthesis; energy metabolism in domestic animals; mineral metabolism; vitamins - structure and metabolic role.
- Biochemistry of blood- plasma proteins and functions, changes in disease, inherited deficiency of plasma protein fractions
- Haemoglobin chemistry- coagulation and haemolysis of blood, lymph, tissue fluid and other body fluids
- Biochemistry of hormones- structure and metabolic role
- Biochemical process in health and disease conditions- biochemistry of respiration, renal function, stress and shock and detoxification.
- Immunochemistry- nature of antigens and antibody, structure of antibodies
- Diagnostic biochemistry- blood sugar, ketone bodies, blood urea nitrogen and uric acid, enzymes
- Basic principles of biosynthesis of proteins and nucleic acids, genome, gene sequencing, DNA, RNA, PCR, hybridomas and monoclonal antibodies, DNA probe, *in-vitro* fertilization and embryo transfer and cloning
- Recent approaches on the use of biotechnology tools in veterinary practices.

Veterinary Microbiology and Immunology

- General description and classification of infectious organisms
- Morphology, isolation, growth, colonial, biochemical and antigenic characteristics, pathogenicity, and the disease caused in farm animals, pets and poultry by *Staphylococcus*, *Streptococcus*, *Moraxella*, *Brucella*, *Enterobacteriaceae*, *Pseudomonas*, *Leptospira*, *Vibrio*, *Aeromonas*, *Pasteurella*, *Yersinia*, *Actinobacillus*, *Actinomyces*, *Corynebacterium*, *Mycobacterium*, *Bacillus*, *Clostridium*, *Listeria*, *Erysipelothrix*, *Nocardia*, *Bacteroides*, *Haemophilus*, *Bordetella*, and *Spirochaetes*.
- Morphology, isolation, growth, colonial, biochemical and antigenic characteristics, pathogenicity, and the disease caused in farm animals, pets and poultry by rickettsia, and chlamydia

**Nepal Agricultural Research Council
Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

- Morphology, isolation, growth, colonial, biochemical and antigenic characteristics, pathogenicity, and the disease caused in farm animals, pets and poultry by *Mycoplasma* and *Acholeplasma*.
- Morphology, isolation, growth, colonial, biochemical and antigenic characteristics, pathogenicity, and the disease caused in farm animals, pets and poultry by fungus (*Candida*, *Mycetomal*, *Sporotrichum*, *Aspergillus*, *Cryptococcus*, *Histoplasma*, *Rhinosporidium*, and others).
- Diseases caused by mycotoxins
- Viruses and their classification, DNA and RNA viruses and their importance in veterinary medicine
- Cultivation of viruses in developing chicken embryos, primary cell cultures and cell lines and animals
- Replication of RNA and DNA viruses and regulation of virus multiplication
- Viral genetics and interactions with references to mutation, genetic recombination
- General characteristics of various families of DNA and RNA viruses causing diseases in livestock and poultry with reference to virus antigens, cultivation, pathogenesis, epidemiology, diagnosis and immunity of Pox virus, Iridovirus, Herpes virus, Adenovirus, Papovavirus, Orthomyxovirus, Paramyxovirus, Arbovirus, Rhabdovirus, Coronavirus, Togavirus, Picornavirus, Birnavirus, Parvovirus and Retrovirus.
- Concept of virulence, pathogenicity, infection and immunity
- Principles of immunity and immune mechanisms
- Cellular and humoral immunity and mechanisms involved in it
- Immune responses their development and specificity
- Hypersensitivity and allergy
- Immunodiagnostic tests used in veterinary diagnostics
- Development of resistance against therapeutic agents in the microorganism and its mechanism.

Veterinary Parasitology

- Development of veterinary parasitology and its importance
- Parasites of veterinary importance and their classification
- Parasites, parasitism, commensalism and symbiosis
- Host -parasite relationship and specificity between parasites and hosts and development of parasites in the host system.
- Nomenclature and classification of parasites and characteristics of various phyla of parasites.
- General morphological characteristics of different types of helminths, arthropods and protozoa
- Tissue reactions of parasites in the hosts and development of immunity/resistance to parasite infection/infestation

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- Natural and acquired immunity, parasitic immunity
- Life cycle and mode of transmission of different types of helminths, arthropods and protozoan parasites infecting farm animals, pets and poultry.
- Important morphological features, life cycles, mode of transmission, pathogenesis, diagnosis, chemo and immunoprophylaxis and general control measures of intestinal flukes and liver flukes, amphistomes, visceral and nasal schistosomes.
- Important morphological features, life cycles, mode of transmission, pathogenesis, diagnosis, chemo and immunoprophylaxis and general control measures of tapeworms of farm animals, pets and birds and development of bladderworm with emphasis on metacestodes of zoonotic importance.
- Important morphological features, life cycles, mode of transmission, pathogenesis, diagnosis, chemo and immunoprophylaxis and general control measures of nematode parasites of farm animals, pets and birds.
- Important morphological features, life cycles, mode of transmission, pathogenesis, diagnosis, chemo and immunoprophylaxis and general control measures of arthropod parasites of farm animals, pets and birds.
- Important morphological features, life cycles, mode of transmission, pathogenesis, diagnosis, chemo and immunoprophylaxis and general control measures of protozoan parasites of farm animals, pets and birds.
- The epidemiology of parasitic diseases and recent approaches for the control of parasitic diseases
- Mechanism of resistance development against antiparasitic agents and detection of resistance.
- Recent approaches on the control of parasitic diseases of farm animals

Veterinary Pathology

- History and scope of pathology.
- Causes of disease and the factors associated with diseases of farm animals, pets and birds
- Developmental disturbances, anomalies and monsters
- Disturbances of circulation- embolism, thrombosis, haemorrhage, edema, shock
- Disturbances of cell metabolism- gout, amyloid infiltration, mucoid degeneration
- Disturbances of pigment metabolism and icterus
- Necrosis, gangrene and PM changes
- Disturbances of growth- atrophy, aplasia, hyperplasia, hypertrophy, metaplasia
- Inflammation- causes, signs, effects, classification,
- Healing and fever
- Concretions - uroliths, choleliths, enteroliths,
- Hypersensitivity and autoimmunity
- Pathology of cardiovascular system- functional disturbances and malformation of heart, arteries and veins, lymph node, vessels and spleen, blood, bone marrow; anemia

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)

Open and Internal Competition Examination

- Pathology of respiratory system- functional disturbances and malformation of nasal cavity, larynx, bronchi, lungs and pleura
- Pathology of digestive system- functional disturbances and malformation of organs of digestion.
- Pathology of urogenital system- functional disturbances and malformation of organs of urinary and genital system of male and female animals.
- Pathology of nervous system and sensory organs- functional disturbances and malformation of meninges, brain and spinal cord and sense organs.
- Pathology of endocrine system- functional disturbances and malformation of endocrine glands.
- Neoplasm- classification, cause and pathology of different types of tumour, difference between benign and malignant tumour
- Pathology of the diseases caused by viruses in farm livestock, pets and poultry
- Pathology of the diseases caused by bacteria in farm livestock, pets and poultry
- Pathology of the diseases caused by fungus, parasites and protozoa in farm livestock, pets and poultry
- Pathology of the diseases caused by nutritional deficiency and metabolic diseases in farm livestock, pets and poultry
- Pathology of the common diseases found in wild/zoo animals and laboratory animals.

Veterinary Pharmacology and toxicology

- Development and scope of veterinary pharmacology
- Principles of drug activity: pharmacokinetics –absorption, distribution, biotransformation and excretion of drugs
- Pharmacodynamics- concept of drug and receptors, dose-response relationship, terms related to drug activity and factors modifying the drug effect and dosage.
- Drugs acting on central nervous system
- History and theories of general anaesthesia; volatile, gaseous, intravenous and dissociative anaesthetics, hypnotics and sedatives, tranquilizers, analgesics
- Antipyretics, analgesics, and anti inflammatory agents
- Transmitters of CNS, analeptics and other CNS stimulants
- Local anaesthetics
- Neuromuscular blocking agents
- Peripheral and central muscle relaxants
- Drugs acting on autonomic nervous system-adrenergic antagonists, adrenoceptors blockers, adrenergic neuron blockers, cholinergic antagonist and blockers, ganglionic stimulants and blockers,
- Histamine and antihistaminic agents
- Prostaglandins, angiotensin and bradykinin
- Drugs acting on cardiovascular system

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- Drugs acting on digestive tract
- Drugs acting on respiratory system
- Drugs acting on endocrine system- adrenocorticosteroid, sex hormones, insulin and other hypoglycaemic agents, thyroid hormones
- Drugs acting on skin and mucus membrane
- Antibacterial agents- classification, general principles in antibacterial chemotherapy, sulphonamide and their combination; antibiotics; antituberculous agents; miscellaneous agents
- Antifungal agents
- Anthelmintics and antiprotozoal agents;
- Antiviral and anticancer agents
- Antiseptics and disinfectants
- Hormones –hormone stimulating and inhibiting drugs, antagonists, hypoglycaemic agents, prostaglandins, oxytocin, anabolics, growth promoters and corticosteroids
- Commonly used herbal drugs used in veterinary medicine
- General toxicology: scope, source of poisoning, mode of action of poisons, factors modifying toxicity and line of treatment of poisoned cases
- Toxicity caused by metals and non metals-arsenic, lead, mercury, copper, selenium, phosphorus, nitrates, nitrite, common salt and fluorosis
- Plant toxicity due to various poisonous plants
- Toxicity caused by commonly used drugs, mycotoxins, bacterial toxins and others
- Toxicity caused by agrochemicals, insecticides, herbicides and rodenticides
- Venoms, bites and stings
- Environmental toxicity- toxicity caused by air, water, food additives and preservatives

Meat Hygiene and Public Health

- Organisation, layout and management of slaughterhouses,
- Pre-slaughter care of animals, handling and transport of meat animals, ante-mortem examination
- Techniques of humane slaughtering
- Different techniques of slaughtering and dressing
- Chilling, ageing and evaluation of dressed carcasses and carcass yield
- Utilisation of slaughterhouse by products
- Disposal of condemned parts and animals suffering from notifiable diseases
- Examination of carcasses of different livestock species for meat borne diseases
- Development of meat industry-structure, composition, nutritive value post mortem changes and eating quality of meat tissues
- Principles of various preservation techniques
- Standard and quality control measures adopted for meat and meat products
- Fraudulent substitution of meat and its recognition

**Nepal Agricultural Research Council
Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

- Chemical composition and nutritive value of meat obtained from farm livestock and poultry
- Zoonotic diseases and their diagnosis, treatment and control
- Role of veterinarian for the control of zoonotic diseases

Veterinary Surgery

- Methods of restraints, surgical techniques sutures and suturing
- Preoperative care of animals
- Use of general and local anaesthesia in farm animals, horses, dogs and cats
- Wound repair and management of wounds
- Surgical management of abscesses, gangrene and fistulae
- Management of fractures and dislocation
- Surgical management of injuries and affections of head and neck- otitis media, entropion, extropion, nictitating membrane, hydrophthalmus, corneal injuries and opacities, paralysis of facial nerve, nasal polyp, empyema of sinuses, cleft palate, teeth abnormalities, horn injuries, poll evil, guttural pouches, tracheotomy, oesophagotomy
- Surgical management of injuries and affections of shoulder and limbs: sit fast, hematoma, collar gall, fistulus withers, brachiocephalic abscesses, capped elbow, amputation of limbs, arthritis, hygroma of carpus, splints, synovitis, tendinitis, wind gall, grease heel, thrush, laminitis, sand crack, corns, canker
- Operative treatment of navicular bursa
- Surgical management of injuries and affections of thoracic and abdominal cavities – laparotomy, rumenotomy, intestinal obstruction, colic, cesarean section, hysterectomy, hernias
- Surgical management of injuries and affections teats and mammary gland- trauma, wounds and injuries, milk fistulas, imperforate teats, contracted sphincter, spider teats, amputation of teats and extirpation of udder
- Surgical management of injuries and affections of male and female genital tracts- orchitis, castration, vasectomy, cryptorchid, prolapse of vagina, cervix, uterus, bladder and prepuce, spaying, phimosis and paraphymosis, urethrotomy and removal of urethral calculi
- Amputation of tail, surgical management of atresia ani
- Post-operative care of animals

Veterinary Gynaecology and Obstetrics

- Development and description of genitalia of male and female farm animals and pets
- Growth, puberty, sexual maturity in relation to reproduction in male and female farm animals and pets
- Role of hormones in various phases of reproduction in male and female farm animals and pets

**Nepal Agricultural Research Council
Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

- Sexual behaviour of male and female animals and factors affecting the sex libido of animals
- Symptoms of oestrus and oestrus cycle in domestic animals and factors affecting oestrus cycle, detection of oestrus and stages of oestrus, oestrussynchronisation, ovulation and transport of ovum and sperms,
- Fertilization, development of foetus, foetal membrane and placenta, gestation period, stages of gestation
- Manipulation of oestrus, ovulation, *in-vitro*fertilisation and embryo transfer
- Maintenance of pregnancy and pregnancy diagnosis by different methods, differential diagnosis of pregnancy,
- Diseases and accidents during pregnancy, causes of premature birth, early embryonic death, abortion-causes, treatment and control, intrauterine death, mummification, metritis and pyometra.
- Fertility, infertility and sterility- functional infertility, anoestrus, ovarian hypoplasia, cystic ovary, repeat breeding, Infectious infertility- specific and non infectious infections affecting genital organs of male and female animals
- Infertility of farm animals in Nepal and the approaches to alleviate it.
- Sexual health control and herd reproductive health programme
- Male infertility and its forms, -factors affecting male infertility, diseases of sex organs and accessory sex glands of male animals,
- Parturition in domestic animals, causes and stages of parturition, expulsion and retention of placenta,
- Intrauterine presentation of foetus, dystokia, its causes and management, caesarian section.
- Parturition hygiene, care and management of newborn and dam, udder health care,
- Post partum diseases and complications- prolapse, vaginitis, cervicitis, metritis, pyometra, post partum paraplegia, milk fever
- Clinical use of hormones and prostaglandins in reproduction management in farm animals
- Artificial insemination- introduction, history, development, advantage and limitation of AI, methods of semen collection and processing in different farm animals, techniques of AI, factors affecting quality and quantity of semen, semen abnormalities and tests for evaluation of semen quality, semen metabolism, biochemistry of semen of farm animals
- Problems associated with artificial insemination in Nepalese farm animals

Veterinary Medicine, ethics and jurisprudence

- History and scope of medicine, concept of animal disease, health and disease concept, etiological agents, infection and immunity
- Clinical examination and diagnosis of diseases in the sick animals
- General and systemic states, hyperthermia, hypothermia, fever, toxæmia, septicaemia, shock and dehydration

**Nepal Agricultural Research Council
Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

- Definition, etiology, clinical symptoms, pathogenesis, clinical pathology, diagnosis, treatment, prevention and control of the diseases of digestive, respiratory, cardiovascular and lymphatic, urogenital, nervous, sense organs, skin, musculoskeletal systems of cattle, buffaloes, horses, pigs, sheep, goats and pet animals.
- Diseases of new born animals
- Definition, etiology, clinical symptoms, pathogenesis, clinical biochemistry, clinical pathology, diagnosis, treatment, prevention and control of metabolic diseases (like: milk fever, ketosis, lactation tetany, downer cow syndrome, hypomagnesaemia) and nutritional deficiency diseases in domestic animals, pets and poultry.
- Incidence, etiology, epidemiology, transmission, clinical symptoms, pathogenesis, clinical biochemistry, clinical pathology, diagnosis, treatment, prevention and control of diseases caused by bacteria, viruses, chlamydia, rickettsia, protozoa, parasites and fungi in domestic animals, pets and poultry.
- Definition, etiology, clinical symptoms, pathogenesis, clinical biochemistry, clinical pathology, diagnosis, treatment, prevention and control of diseases caused by physical and chemical agents.
- Diseases caused by allergy
- Diseases caused by undesirable inherited characters and unknown etiologies
- Vaccines and vaccination and recent development in vaccine production
- Legal duties of veterinarians, forensic and state medicine, laws, common offences against animals and laws related to those offences, legal points and examination of live and dead animals in criminal cases, mischief, killing, maiming and poisoning, cruelty to animals and bestiality.

Veterinary Epidemiology and Statistics

- Definition, aims, objectives and applications of epidemiology and preventive medicine
- Ecological concept of epidemiology
- Disease process and its spread, pattern of disease distribution in the community,
- Multifactorial causation of diseases, agent, host and environmental strategies of epidemiology
- Types of epidemiological studies-case control, cohort studies
- Investigation of epidemic
- Prevention control and eradication of diseases
- Laws regulating animal diseases including the laws regulated by international organisation (OIE)
- Categorisation of communicable diseases
- Regulations regarding handling, import and export of biomaterials

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- Statistics:
 - Probability, frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling theory, test of hypothesis, confidence intervals
 - Students t test, Chi-square test, F test
 - Estimate of error- replication and randomization
 - Complete randomized design-randomization, layout and analysis of variance
 - Randomized complete block design-layout, randomization, analysis of variance
 - Two factorial experiment- randomization, layout and analysis of variance, interaction
 - Comparison - pair comparison by least significant difference, group comparison-between group comparison, within group comparison
 - Regression and correlation - simple linear and nonlinear, multiple linear and nonlinear; correlation
 - Importance and use of Statistics in bio-sciences research

Genetics and principles of animal breeding

- Study of animal cell, chromosome number of different species of livestock and poultry,
- Cell division and behaviour of chromosomes during mitosis and meiosis
- Mendelian principles, dihybrid and polyhybridisation
- Gene interaction, epistasis, multiple alleles
- Linkages and crossing over
- Sex controlled inheritance and sex determination
- Modified Mendelian inheritance-lethal and sublethal characters, mutation, chromosomal aberration, cytoplasmic inheritance
- Quantitative inheritance- Genetic constitution of population, gene frequency, genotype frequency, Hardy Weinberg's law, selection and effect of selection, migration, mutation and population size on gene frequency
- Values and means-population mean, average effect, breeding value, genetic, phenotypic and environmental variance, heritability
- Breeds and their classification and basis of classification, Important native and exotic breeds of farm animals, pets and poultry, concept of environment and genotype
- Heritability, repeatability, genetic and phenotypic correlation of different traits of economic value
- Selection and methods of selection, basis of selection, response to selection and its measures, selection differential, sire index, selection index, recurrent and reciprocal selection
- Breeding methods-different mating systems, inbreeding and its measure, effect and application of inbreeding with its merits and demerits, inbreeding coefficient and coefficient of relationship, line breeding; open nucleus breeding, out breeding (cross breeding)

**Nepal Agricultural Research Council
Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

- Heterosis- causes, measurement and application in animal breeding, outcrossing, topcrossing, grading up, criss crossing, rotational crossing, incrossing, species hybridization,
- Breeding behaviour, Importance of recording of breeding performance,

Animal Nutrition:

- Importance of nutrition and nutrients in animal health and production, composition of animal body and plants, biochemical basis of animals, plants and soil.
- Nutrients in the feed, their digestion and metabolism in ruminants, non-ruminants, pets and birds
- Role, requirements and deficiency symptoms of nutrients (water, carbohydrate, proteins, lipids, vitamins and minerals) in farm animals, dogs, cats and horses.
- Feed additives in the ration of animals and poultry
- Antibiotics and other hormonal compounds and growth promoters in the animal feed, their use and abuses
- Measures of feed energy and their application
- Chemical composition and nutritive value of various feeds and fodders
- Use of agro-industrial by-products and agricultural waste as animal feed.
- Utilization of unconventional feeds and recent approaches on the use of NPN in ruminant feed.
- Economics and efficiency of feed conversion to animal products
- Feeding of young animals and animals with different stages of production in farm animals, pets and poultry.
- Formulation of feeds for farm animals, pets and poultry.
- Importance of colostrum suckling and composition of different milk formulae

Livestock Production management and Economics

- Introduction to animal husbandry, body conformation and identification of common breeds of cattle, buffaloes, sheep, goats, horses, pigs, poultry and pets
- Common vices of animals, their prevention and care
- Factors affecting health of livestock and care and management of sick animals
- Disinfection, isolation, quarantine and segregation of sick and healthy animals
- Dentition and age determination of animals
- Care and management of young, pregnant, dry and lactating animals
- Care and management of animals during transport via different means
- Medication, vaccination and other preventive approaches
- Feeding management of farm livestock, pets and poultry
- Watering management of farm livestock, pets and poultry
- Housing management of farm livestock, pets and poultry during different stages of production, ventilation, light, flooring, drainage

**Nepal Agricultural Research Council
Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

- Proper disposal of animal waste from the animal houses, general principles of sewage disposal and purification, compost making, drainage, storage and disposal of solid and liquid manure
- Effect of environment on health and production of animals and methods to counter
- Importance of grasses and fodder in livestock production and agronomical practices for production of leguminous and non-leguminous grasses
- Role of tree fodder and crop by-products for livestock feeding in Nepal
- Feeding and management of cattle and buffaloes, economic traits, their selection and management
- Economics of dairy farming and development plans for commercial dairy farming
- Importance of sheep and goat rearing for meat and wool production
- Selection of sheep and goats for wool and meat production
- Feeding and management of sheep and goats for wool and meat production
- System of sheep and goat management in the country and their importance
- Economics of sheep and goat rearing under different system of management and development of plans for commercial production
- Poultry production: importance, system of management and management of birds under different systems
- Selection and culling of birds under commercial management
- Selection, handling and incubation of hatching eggs
- Management of birds for broiler and egg production
- Economics in poultry production, preparation of projects for commercial poultry production
- Production management of swine and equines
- Care and management of laboratory and pet animals
- Care and management of wild and zoo animals
- Composition and nutritive value of milk and milk products produced from milk of cattle, buffaloes, yak and goats.
- Principles of hygienic milk production and precautions required for it.
- Principles involved in pasteurisation, homogenisation and dehydration.
- Preparation of various concentrated and dehydrated milk products and meat products.
- Legal and national standards required for milk and milk products
- Utilisation and role of milk and milk by-products in human nutrition in Nepal.

Research management

- Development of research proposal and writing of technical report
- Design of experiments and their effective implementation
- Monitoring and supervision of experimental studies
- Programme planning and budgeting
- Development of research programmes on national priorities

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

General:

- The objectives, role and activities of Nepal Agricultural Research Council (NARC) for national agricultural development.
- Composition and organization of NARC board and council
 - The present contribution and future potential of livestock for national agricultural development
 - Role of livestock/veterinary research for overall livestock development
 - Main constraints of livestock/veterinary research in Nepal and the ways to alleviate these constraints.
 - Agriculture prospective plan and the projected role of livestock in it.
 - Tenth five year plan

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination
Sub Faculty - Livestock Products, Production and Management

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

Care and Management of calves to breedable age.

Breeding and Feeding management of heifers.

Management of AI and ET in cattle.

Care and feeding , Management and health of pregnant heifers and adult animals.

Management of Steaming Up in advanced pregnant animals.

Improved Housing Management for calves, heifer and pregnant animals and Milking animals.

Management of Crossbred bulls (Cattle / Buffalo) production for breeding purpose.

Feeds and Feeding:

Nutrient requirement

Low cost feed Formulation

Milk Production:

The process of lactation

Hormonal influence in lactation

Release of milk from the udder

Definition of milk and composition

Preparation of Khuwa, Paneer, Yoghurt, Chhurpi and Ghee, Cheese with low cost

Equipment Management.

Sheep and Goat:

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

Management system: Transhumance system and Sedentary 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

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sheep / Goat

Reproductive behavior and Breeding systems
Breed Improvement
Mating Systems
Artificial Insemination
Reproduction in Doe
Fertility in doe:
Objectives of breeding plan.

Feeds and Feeding:

Nutrient requirement
Formulation of Ration

Disease and Parasites:

Common diseases, Infectious disease, Noninfectious disease
Internal and External parasites
Prevention and control

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:
 1. Body Growth and Development
 - 1.2 Anatomical Component of the animal body.
 - 1.2.1 Bone and Nervous systems
 - 1.2.2 Essential organs- Heart, Brain, Liver
 - 1.2.3 Bones
 - 1.2.4 Muscle
 - 1.2.5 Fat
2. Definition of Carcass, offal (Edible and non edible), Dressing Percentage
3. Factors influencing the pattern of growth and development in meat animals.

Wool Production (Sheep and Angora rabbit)

- A. Properties of wool
 1. Strength and elasticity
 2. Effect of moisture

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

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

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

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

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

Layers management for efficient egg production

Breeding management

Culling, Selection of laying hens

Replacement of old laying poultry flock with new pullet.

Angora rabbit (wool and meat) production / management

Types of prevailing buffalo, sheep and goat marketing systems

Research Methodology:

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

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Animal Breeding and Genetics

1. Principles of Genetics and Population Genetics

Definition, importance and history of genetics

Study of animal cells

Chromosomes, types of chromosomes and number of chromosomes in different animals

Cell division

Mendelian principles

Dihybrid and polyhybridization

Genetic constitution of population-frequencies of genes and genotypes, Hardy-Weinberg equilibrium

Gene interaction, epistasis and multiple alleles

Linkage and crossing over

Sex controlled inheritance and sex determination

Mutation and chromosomal aberrations

Cytoplasmic inheritance

Quantitative inheritance

Heredity and environment

Genetic forces changing gene frequencies-selection, migration, mutation and population size

Coefficient of inbreeding and genetic relationship

Values and means; breeding values

Variances-genetic and environmental

Resemblance-genetic and phenotypic

2. Principles of Animal Breeding

Definition, importance, achievements and history of Animal Breeding

Application of genetic principles in Animal Breeding

Gene and genotypic frequencies

Qualitative and quantitative inheritance

Heredity and environment

Principles of mating systems

Basis and methods of selection

Hybrid vigour/heterosis and estimation of heterosis

Genetic gain/Response to selection

Heritability

Repeatability

Correlations-Genetic, phenotypic and environmental

Dissemination methods

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

3. Molecular Genetics

Definition, importance and history of Molecular Genetics
Structure of DNA, Replication of DNA
Transcription and Translation
Plasmids
Isolation of DNA
Electrophoresis
Polymerase Chain Reaction (PCR)
DNA Finger Printing
Transgenic animals
Biological or genetic basis of disease resistance
Polymorphism

4. Biotechnology

Definition, scope and importance of Biotechnology
Application of Biotechnology tools in Animal Improvement
Artificial Insemination
Embryo collection, embryo transfer
In vitro fertilization
Animal cloning

5. Reproduction and Physiology

Reproductive systems of domestic animals
Reproduction parameters in domestic animals
The estrous cycle
Hormones
Heat synchronization using hormone
Pregnancy and calving
Reproductive efficiency

6. Statistics

Definition and importance of Statistics
Experimental design
Central tendency and measures of dispersion as tools for measuring quantitative inheritance/traits
Analysis of Variance (ANOVA)
Analysis of Covariance (ANCOVA)
Regression and Correlation analysis
Introduction to relevant statistical packages for analysing breeding data

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Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Least Squares Analysis
Mixed Model Methodology
Best Linear Unbiased Prediction (BLUP)

7. Animal Genetic Resources

Biodiversity
Identification of indigenous breeds of domestic animals
Characterization of indigenous breeds of domestic animals
Status of indigenous breeds in relation to conservation
Positive attributes of indigenous breeds
Methods of conservation-Insitu and Exsitu

8. General

Nepal Agricultural Research Council
Tenth five year plan
Agricultural perspective plan
Available introduced breeds
Animal Genetic Resources Management and Utilization: Policy and Strategy
Current breeding programmes in the country

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - 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.

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 Cropping systems, crop rotation, inter-cropping , mixed cropping , multiple cropping and mixed farming systems.
- 4.9 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

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Syllabus for Scientist (S-1)
Open and Internal Competition Examination

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 Fodder and feed from trees and shrubs , grassland productivity and carrying capacity, productivity influencing factors.
- 6.7 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

9. Forage Conservation.

- 9.1 Principles of conservation
- 9.2 Silage making
- 9.3 Hay making

10. Forage Toxicology

- 10.1 Antiquality 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.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 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 insect 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.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub-Faculty: Animal Nutrition and Feeding

1. General

- 1.1 Production and Productivity of livestock and avian in Nepal.
- 1.2 Existing livestock and poultry feeding system in the country.
- 1.3 Pasture, Forage and Agro forestry production in Nepal.
- 1.4 Organic Chemistry.
- 1.5 Hydrocarbon
- 1.6 Derivatives of hydrocarbon.
- 1.8 Bio-Chemistry
- 1.9 General knowledge about NARC

2. Feedstuffs.

- 2.1 Terms and definitions
- 2.2 Proximate analysis of feeds.
- 2.3 Energy value of feeds.
- 2.4 Protein values of feeds.
- 2.5 Measuring the intake and utilization of energy and nutrients of feeds.

3. Nutritional requirements of animals.

- 3.1 The energy requirements of animals.
- 3.2 Requirements of protein.
- 3.3 Requirements for minerals, vitamins and additives.
- 3.4 Feeding Standards.

4. The nutritional characteristics of some common feeds.

- 4.1 Classification of feeds.
- 4.2 Basal feeds.
- 4.3 Protein supplements.
- 4.4 Vitamin and mineral supplements and additives.
- 4.5 Forages and roughages.

5. Ration Formulation.

- 5.1 Formulae for cattle/buffalo feed mixtures.
- 5.2 Formulae for swine/rabbit feed mixtures.
- 5.3 Formulae for poultry feed mixtures.
- 5.4 The preparation of mixed mineral supplements.
- 5.5 Linear programming of feed mixtures.

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 6. Cultivation of pasture, forage and fodder tree and their nutritional status in various stages of growth.**
- 7. Digestive system of ruminant and non - ruminant domestic species and factors affecting to improve the efficiency of digestive system.**
- 8. Common methods of analysis of nutrients and feed stuffs. Proximate analysis**
- 9. Statistics.**
 - 9.1 Organization and description of data.
 - 9.2 Probability.
 - 9.3 Introduction to statistical inference.
 - 9.3.1 Sampling distributions and estimation.
 - 9.3.2 Hypothesis testing.
 - 9.3.3 Analysis of variance
 - 9.3.4 Regression and correlation analysis
- 10. Feed stuffs classifications**
- 11. Animal feed processing and improving the efficiency of feed stuffs**

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Fishery

1. Aquaculture:

- 1.1 Principle of aquaculture
- 1.2 Freshwater aquaculture system
- 1.3 Prospect of freshwater aquaculture
- 1.4 Aquatic plants and fish production
- 1.5 Biological characteristics of cultured carp fish species
- 1.6 Brood fish management
- 1.7 Alternative management system for maximum profit
- 1.8 Intensive aquaculture system
- 1.9 Intensive aquaculture design and management
- 1.10 Efficiency and limitation of intensive culture system
- 1.11 Propagation of cultured fish species
- 1.12 Hatchery technique of induced propagation of cultured carps for pond fish farming
- 1.13 Site selection criteria
- 1.14 Ponds design
- 1.15 Pond fish preparation
- 1.16 Water supply system
- 1.17 Aeration
- 1.18 Nursing and rearing of fish fry
- 1.19 Transportation of fry, fingerlings and brood fish
- 1.20 Feed and fertilization
- 1.21 Polyculture
- 1.22 Integrated fish farming system with
-pig, poultry, cattle, vegetable, sericulture, rice fish culture
- 2.23 Cage fish culture, enclosure/pen culture, open water fish culture
- 1.23 Advantage of integrated pond fish farming
- 1.24 Site selection and design of integrated fish farming
- 1.25 Natural (Inland) water management for aquaculture

2. Endocrinology:

- 2.1 Endocrine systems related to reproduction and growth
- 2.2 Anatomy, physiology, bio-chemistry and regulation of endocrine gland
- 2.3 Hormone application

3. Application of chemicals

- 3.1 Chemicals and drugs used in aquaculture for improving water quality
- 3.2 Prevention and control of diseases
- 3.3 Effects of chemicals and drugs on pond ecosystem

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

4. Genetic improvement:

- 4.1 Improvement by selection
- 4.2 Mating system
- 4.3 Hybridization
- 4.4 Polyploidy inclusion
- 4.5 Gynogenesis and androgenesis
- 4.6 Genetic engineering
- 4.7 Application of molecular genetic techniques
- 4.8 Genetic improvement of aquaculture stocks through marker

5. Water quality management in aquaculture

- 5.1 Water quality criteria for aquaculture in hatchery and grow out
- 5.2 Pond bottom soil management
- 5.3 Relationship of pond bottom soil and water quality and its effect
- 5.4 Prevention and control of water quality problems by water quality management
- 5.5 Water chemistry: Dissolved Oxygen, (night time demand of dissolved oxygen, prediction of night time dissolved oxygen decline, phytoplankton die-off, thermal stratification, toxic chemicals), pH, CO₂, Hardness, Alkalinity, Carbondioxide, mineral acid, phosphorus, ammonia, nitrate, nitrite, Sulphide, oxidation, reduction, iron, conductivity,
- 5.6 Liming
- 5.7 Phytoplankton control
- 5.8 Chemical treatment
- 5.9 Water sampling
- 5.10 Chemical analysis
- 5.11 Plankton analysis

6. Fish nutrition:

- 6.1 Feed conversion and nutrition requirement
- 6.2 Feed formulation
- 6.3 Feed preparation and nutritional value
- 6.4 Feed production and quality control
- 6.5 Major nutrients
- 6.6 Vitamins
- 6.7 Essential minerals

7. Physiology and ecology of fish:

- 7.1 Physiology system and osmo-regulation of fish
- 7.2 Function of organ system and their relation
- 7.3 Environmental factors effect to fish living

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

- 7.8 Ecology of fish fresh water fish
- 7.9 Factors affect survival and migration
- 7.10 Environmental factors that correlated to distribution of fish

- 8. Fish pathology:**
 - 8.1 General fish disease and their control
 - 8.2 Types of general fish diseases
 - 8.3 Characteristics of pathology
 - 8.4 Source of pathogens
 - 8.5 Environmental affect upon out break disease
 - 8.6 Prevention of disease

- 9. Plankton:**
 - 9.1 Advantage and disadvantage of plankton production for fisheries
 - 9.2 Plankton culture
 - 9.3 Relationship between phytoplankton and zooplankton
 - 9.4 Methods and techniques to measure the productivity
 - 9.5 Food chain and energy recycling

- 10. Statistics:**
 - 10.1 Definition of statistical analysis
 - 10.2 Standard deviation and normal distribution
 - 10.3 Correlation
 - 10.4 Regression
 - 10.5 Probability
 - 10.6 Analysis of variance (ANOVA)

- 11. General**
 - 11.1 Nepal Agricultural Research Council (Establishment, Objective, Role and Activities)
 - 11.2 Present Aquaculture status in Nepal
 - 11.3 Constrains for fisheries research and fish production in Nepal

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

वैज्ञानिक एस.१ पद, लाइब्रेरी साइन्स उप समुहको खुल्लाप्रतियोगितात्मकलिखित परीक्षाको लागि पाठ्यक्रमएवं परीक्षा योजना

यस पाठ्यक्रमलाई दुई चरणमा विभाजनगरिएको छ ।

प्रथम चरण: लिखित परीक्षा(Written Examination)

पुर्णाङ्क: २००

द्वितीय चरण: अन्तरवार्ता (Interview)

पुर्णाङ्क: ३०

प्रथम चरण: लिखित परीक्षा योजना(Written Examination Scheme)

Paper	Subject	Marks	Full Marks	Pass Marks	No. Questions and Weightage	Time Allowed
I	Part I: General Information on Library and Documentation	75	75	80	5 x 9 = 45 (Short answer) 2 x 15 = 30 (Long answer)	3:00 hrs
II	Part II: Technical Subject	125	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 परीक्षाको माध्यमभाषा नेपालीवाअंग्रेजीअथवा नेपाली र अंग्रेजीदुवै हुन सक्नेछ ।
- पाठ्यक्रममाभएकायथासंभव सबै पाठ्याशंहरुबाट प्रश्न सोधिनेछन् ।
- यस पाठ्यक्रममा जे सुकै लेखिएको भएतापनि पाठ्यक्रममा परेका ऐन, नियमहरु, परीक्षाको मितिभन्दा३महिना अगाडी (संशोधनभएका संशोधितभई हटाईएकावाथप गरी शंसोधितभई कायम रहेका) लाई यस पाठ्यक्रममा परेको संभन्नु पर्दछ ।

Nepal Agricultural Research Council
Syllabus for Scientist (S-1)
Open and Internal Competition Examination

Sub Faculty - Library Science

Part I: General Information on Library and Documentation

1. Library and Society

- 1.1 History of Agricultural System in Nepal, NARC structure and Law.
- 1.2 Role of Communication, Publication and Documentation Division of NARC.
- 1.3 Types of libraries: their aims, objectives and functions.
- 1.4 Law of library science
- 1.5 ISBN and ISSN system in Nepal.

2. Library and Information Management

2.1 Management

- 2.1.1 Library Management: Definition, Nature, Purpose, Characteristics and Functions
- 2.1.2 Management Skills: Technical, Human Resources
- 2.1.3 Scientific Management: Functions and Principles

2.2 Planning

- 2.2.1 Library Buildings: Design and Preliminary Considerations
- 2.2.2 Space Management: Areas & Sub-areas

2.3 Financial Management

- 2.3.1 Library Statistics
- 2.3.2 Annual Reports

2.4 Library Committees: Need, Purposes, Functions, Roles & types

3. Library and Information System and Services in Nepal

- 3.1 Nepal National Library
- 3.2 Nepal Library Association

4. Information Sources, Services and Information Literacy

- 4.1 Primary, secondary and tertiary information sources
- 4.2 Non-book materials and electronic sources

Part II: Technical Subject

5 Library House-keeping Operations

- 5.1 Collection Development: Book Plan, Book Policies & Programmes
- 5.2 Acquisition Section, Book Selection, Ordering Procedure, Accessioning
- 5.3 Maintenance: Relationship with other Sections, Stacking, Shelving, Binding, Stock-taking. Preservation and Conservation, IFLAPAC
- 5.4 Circulation Control: Functions, Routines, Registration of Borrowers, Circulation Systems, Inter-library Loan.

6. Library Cataloguing and Indexing

- 6.1 Need, purpose and function of a library catalogue
- 6.2 Physical forms (External form)

**Nepal Agricultural Research Council
Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

- 6.3 Types of catalogue: Internal forms
- 6.4 Data elements in different types of entries
- 6.5 Subject cataloguing & Indexing problems and models (techniques only) specially chain procedure, PRCIS and POPSI

7. Information Processing and Retrieval Technique (Library Classification)

- 7.1 Definition, Need, Purpose and Function
- 7.2 Agro-Voc thesaurus and its use
- 7.3 Introduction to Major Schemes of Classification: DDC, CC, UDC

8. Library Automation

- 8.1 Definition, need, purpose and functions of NARC library automation
- 8.2 Library Management Software e.g. CDS/ISIS or WINISIS
- 8.3 Designing Bibliographic Databases
- 8.4 Library Housekeeping Systems
- 8.5 OPAC
- 8.6 MARC, OCLC

9. Information and Communication Technology

- 9.1 Introduction to computers
- 9.2 Online databases
- 9.3 Webpage design
- 9.4 Need and purpose of ICT in NARC Library
- 9.5 Information Technology (IT) policy of Nepal
- 9.6 Multipurpose Community Telecentres
- 9.7 Free and Open Source Software (FOSS)
- 9.8 Internet and email
- 9.9 Information Network
- 9.10 CD-ROM Databases

**10. E-Libraries **

- 10.1 Need, Importance and justification of e. libraries
- 10.2 Different Component needed to establish e. libraries
- 10.3 State of e. libraries in Nepal
- 10.4 Free e-resources
 - AGORA
 - HINARI
 - OARE
 - DOAJ

11. Bibliography and Documentation

- 11.1 Bibliography: Need, Types, Function, Bibliographic control
- 11.2 Abstracting techniques and types of abstracts, Importance
- 11.3 Documentation: Definition, scope, functions and types.
- 11.4 Documentation services: CAS, SDI, Current contents etc.

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Syllabus for Scientist (S-1)**

Open and Internal Competition Examination

12. Role of library and Information Centers in Education and Research

- 12.1 Research and Librarianship
 - 12.1.1. Role of Librarianship in Research
- 12.2 Research and Librarianship
 - 12.2.1. Definition, Need, Purpose
 - 12.2.2. Role of Librarianship in Research
 - 12.2.3. Areas of Research in Librarianship

- End -