

नेपाल सरकार  
नेपाल कृषि अनुसन्धान परिषद्  
पदपूर्ति समिति

प्राविधिक अधिकृत, टि-६ (T-6) पद/तहको खुला तथा आन्तरिक प्रतियोगितात्मक  
लिखित परीक्षाको पाठ्यक्रम एवं परीक्षा योजना

यस पाठ्यक्रम योजनालाई दुई चरणमा विभाजन गरिएको छ ।

प्रथम चरण: लिखित परीक्षा (Written Examination)

पूर्णाङ्क: २००

द्वितीय चरण: अन्तरवार्ता (Interview)

पूर्णाङ्क: ३०

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

पूर्णाङ्क: २००

Paper	Subject	Full Mark	Pass Mark	No. of Questions (Q) x Mark (M) = Total Marks	Time Allowed
I	Agriculture Research development	100	40	50 Q x 2 M = 100 (MCQs)	45 Minutes
II	Technical Subject (Related Sub-Group)	100	40	8 Q x 5 M = 40 (Short Answer) 6 Q x 10 M = 60 (Long Answer)	3.00 Hours

२. द्वितीय चरण (Second Phase): Interview

पूर्णाङ्क: ३०

Subject	Full Marks	System
Interview	30	Oral

द्रष्टव्य:

- यो पाठ्यक्रम योजनालाई प्रथम चरणमा लिखित परीक्षा र द्वितीय चरणमा अन्तरवार्ता परीक्षा गरी दुई चरणमा विभाजन गरिएको छ ।
- लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुबै हुन सक्ने छ ।
- समान पद/तहको Part I को विषयवस्तु सबै उपसमूहको लागि पाठ्यक्रम एउटै भएको कारण एकिकृत परीक्षा सञ्चालन हुनेछ ।
- प्रथम र द्वितीय पत्रको लिखित परीक्षा छुट्टाछुट्टै हुनेछ ।
- बस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अंक कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अंक दिइने छैन र अंक कट्टा पनि गरिने छैन ।
- बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको विद्युतीय उपकरण तथा क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।
- बस्तुगत बहुवैकल्पिक प्रश्न (MCQs) को लागि एक उत्तरपुस्तिका हुनेछ । विषयगत प्रश्नका हकमा दुई वटा उत्तरपुस्तिकाहरू हुनेछन् ।
- प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन् । परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डको उत्तरपुस्तिकामा मात्र लेख्नु पर्नेछ ।

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९. यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयबस्तुमा जेसुकै लेखिएको भएतापनि पाठ्यक्रममा परेका कानून, ऐन, नियम, विनियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाइएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ ।
१०. प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र द्वितीय चरणको अन्तरवार्तामा सम्मिलित गराइने छ ।
११. प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारको प्राप्ताङ्क र द्वितीय चरणको अन्तरवार्तामा प्राप्त गरेको अंक जोडी योग्यताक्रम अनुसार सिफारिस गरिनेछ ।
१२. यो पाठ्यक्रम तुरुन्त लागू हुनेछ
१३. यस भन्दा अगाडि लागू भएको पाठ्यक्रम खारेज गरिएको छ ।

NARC पदपूर्ति समिति

प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), सबै उपसमूहको खुल्ला प्रतियोगितात्मक  
लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-I**

**Agricultural Research and Development  
(Common For all Sub-Groups)**

1. Constitution of Nepal: Food, agriculture and natural resources related
2. Current National Agricultural policies and plans: National Agriculture Policy, Agricultural biodiversity policy, Climate change policy, Agriculture Development Strategy (ADS), National land use Policy, Seed vision, periodic agriculture development plan
3. NARC Act, NARC bylaws, Structure and responsibilities of Nepal Agricultural Research Council (NARC)
4. International Agricultural Research Organizations - CGIAR and IARCS: CIAT, CIMMYT, CIP, ICRISAT, ICARDA, World Fish, ICRAP, IFPRI, IITA, ILRI, Bioersity international, IRRI, IWMI, AVRDC, ICIMOD, IFDC, IFAD, FAO
5. Geography and Agro-climate condition of Nepal
6. History of Agriculture Development in Nepal
7. Agriculture Extension System in Nepal in the past and present scenario
8. Global warming, Climate Change and its effects in Agriculture sector
9. Major functions, achievements and impact of agriculture research, extension and education in Nepal
10. Agriculture research and development: History, achievements, constraints and scope
11. Agricultural statistics: production, productivity, import/export trend of major agricultural commodities
12. Use and missuse of insecticide and pesticide in agriculture sector

प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), एग्रोनोमी उपसमूहको खुल्ला तथा आन्तरिक  
प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

## **Paper-II**

### **Technical Subject** **Sub-Group: Agronomy**

#### **1. Crop Production**

Rice, wheat, maize, finger millet, barley, buckwheat, legumes, oilseed and cash crops with respect to

- 1.1 Popular recommended varieties
- 1.2 Cultivation and cultural practices - seed treatment, planting time, seed rate, interculture operations, harvesting, cleaning and storage
- 1.3 Weed and weed control.
- 1.4 Manuring and fertilization
- 1.5 Water management
- 1.6 Plant protection measures-important diseases and insects of individual crops and their control measures
- 1.7 IPM and its important
- 1.8 Principle and practices of seed production of major crops

#### **2. Tillage**

- 2.1 Objectives, importance and significance
- 2.2 Concept of zero tillage, minimum and optimum tillage

#### **3. Weed and Weed Control**

- 3.1 Weed and its importance in crop production and types
- 3.2 Common weeds in rice, wheat, maize and their control
- 3.3 Important weedicides used in Nepal in controlling weeds

#### **4. Climate and Weather**

- 4.1 Temperature, rainfall, humidity, sunshine hours, evaporation
- 4.2 Climate of Nepal - climatic zones
- 4.3 Instruments used for different weather parameters in Nepal

#### **5. Soil and Fertilizer**

- 5.1 Soil: definition, soil texture soil structure
- 5.2 Essential plant nutrients and their sources
- 5.3 Chemical fertilizer and percent of nutrient content
- 5.4 Nitrogen, phosphorous and potassium response to major crops
- 5.5 Soil pH and its influence on the availability of nutrients
- 5.6 Soil organic matter and its importance
- 5.7 Soil organisms, and their functions,
- 5.8 Ammonification, nitrification, denitrification, nitrogen fixation
- 5.9 Green manuring crops, their effect on grain yields and constraints associated with green-manuring
- 5.10 Compost/FYM, its use and importance

**6. Cropping patterns of Nepal, relay cropping, mixed cropping and its importance**

**7. Statistics**

- 7.1 Mean, standard deviation, standard error, variance, t-test and tests of significance
- 7.2 Randomized complete block design, layout, randomization, analysis of variance
- 7.3 Data interpretation
- 7.4 Simple linear regression and correlation

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खुल्ला तथा आन्तरिक प्रतियोगितात्मकलिखित परीक्षाको लागि पाठ्यक्रम

## **Paper-II**

### **Technical Subject**

#### **Sub-Group: Plant Breeding and Genetics**

#### **A. Plant Breeding**

##### **1. Importance and Scope**

- 1.1 Importance of plant breeding in the present context of food security and poverty reduction in Nepal
- 1.2 Center of origin of cultivated plants
- 1.3 Qualitative and quantitative characters

##### **2. Breeding Self Pollinated Crops**

- 2.1 Pure line selection
- 2.2 Mass selection
- 2.3 Hybridization
  - 2.3.1 Pedigree method of plant breeding
  - 2.3.2 Bulk method of plant breeding
  - 2.3.3 Backcross method
  - 2.3.4 Determination of population in F<sub>2</sub>

##### **3. Breeding Cross Pollinated Crops**

- 3.1 Mass selection
- 3.2 Progeny selection
- 3.3 Selfing and inbreeding depression in cross-pollinated crops
- 3.4 Incompatibility
- 3.5 Male sterility

##### **4. Polyploidy in plant breeding**

##### **5. Principles and practices of seed production of major crops**

##### **6. Seed testing and seed certification**

#### **B. Genetics**

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

(NB: The examinees are expected to solve problems associated with Mendelian laws of inheritance and Hardy-Weinberg law)

**C. Statistics**

1. Mean, standard deviation, standard error, variance, t-test and tests of significance
2. Randomized complete block design, layout, randomization, analysis of variance
3. Data interpretation
4. Simple linear regression and correlation

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उपसमूहको खुल्ला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

## **Paper-II**

### **Technical Subject**

#### **Sub-Group: Agronomy, Plant Breeding and Genetics**

#### **(a) Agronomy**

##### **1. Crop Production**

Rice, wheat, maize, finger millet, lentil, soybean, rapeseed and sugarcane with respect to

- 1.1 Popular recommended varieties
- 1.2 Development of low cost technology; Cultural practices - Seed treatment if any, planting time, seed rate, interculture, harvest, cleaning and storage.
- 1.3 Weed and weed control.
- 1.4 Manuring and fertilization
- 1.5 Water management
- 1.6 Plant protection measures-important diseases and insects of crops and their control measures
- 1.7 IPM and its important

##### **2. Tillage**

- 2.1 Objectives and significance
- 2.2 Concept of zero tillage, minimum and optimum tillage

##### **3. Weed and Weed Control**

- 3.1 Weed and its importance in crop production and types
- 3.2 Common weeds in rice, wheat, maize and their control
- 3.3 Important weedicides used in Nepal in controlling weeds
- 3.4 Quality seed production and its safe storage for its further use in coming season

##### **4. Climate and weather**

- 4.1 Temperature, rainfall, humidity, sunshine hours, evaporation
- 4.2 Climate of Nepal -climatic zones



## **5. Soil and Fertilizer**

- 5.1 Soil, definition, soil texture soil structure
- 5.2 Essential plant nutrients and their sources
- 5.3 Chemical fertilizer and % of nutrient content
- 5.4 N, P and K response to major crops
- 5.5 Soil pH and its influence on the availability of other nutrients
- 5.6 Soil organic matter and its importance
- 5.7 Soil organisms, and their functions, notes on ammonification, nitrification, denitrification, nitrogen fixation
- 5.8 Green manuring crops, their effect on grain yields and constraints associated with green-manuring
- 5.9 The farming system's, its concept and scope
- 5.10 Compost/FYM use
- 5.11 Outreach research and on-farm trials

## **(b) Plant Breeding**

### **6. Importance and Scope**

- 6.1 Importance of plant breeding in the present context of food security and poverty reduction in Nepal
- 6.2 Center of origin of cultivated plants
- 6.3 Qualitative and quantitative characters

### **7. Breeding Self Pollinated Crops**

- 7.1 Pure line selection
- 7.2 Mass selection
- 7.3 Hybridization
- 7.3.1 Pedigree method of plant breeding
- 7.3.2 Bulk method of plant breeding
- 7.3.3 Backcross method
- 7.3.4 Determination of population in F<sub>2</sub>

### **8. Breeding Cross Pollinated Crops**

- 8.1 Mass selection
- 8.2 Progeny selection
- 8.3 Selfing and inbreeding depression in cross-pollinated crops
- 8.4 Incompatibility
- 8.5 Male sterility

### **9. Polyploidy in plant breeding**

### **10. Principles and practices of breeder seed production of major crops (self-and cross-pollinated)**

## **(c) Genetics**

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11. Cell division with particular reference to meiosis
12. Gregor Mendel: his life and contribution
13. Mendelian principle of segregation
14. Mendelian principle of independent assortment
15. Epistasis and additivity
16. Linkage and crossing over
17. Hardy-Weinberg Law
18. Probability and statistical testing (Chi-square, Binomial Distribution and Normal Distribution)  
(NB: The examinees are expected to solve problems associated with Mendelian laws of inheritance and Hardy-Weinberg law)

(d) **Statistics**

19. Mean, standard deviation, standard error, variance, t-test
20. Tests of significance
21. Randomized complete block design, layout, randomization, analysis of variance
22. Data interpretation
23. Simple linear regression and correlation

प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), हर्टिकल्चर उपसमूहको खुला तथा आन्तरिक  
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## **Paper-II**

### **Technical Subject**

#### **A : Vegetable**

##### **1. Vegetable Production**

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

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

##### **2. Off-Season Vegetable Production**

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

##### **3. Seed Production Technology**

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

- 3.5. Techniques of quality control in vegetable seed production
  - 3.6. Breeder, nucleus and foundation seed production in vegetable
  - 3.7. Seed production methods for open pollinated and hybrid cultivars
  - 3.8. Pre-basic, basic and improved/certified seed production in potato and ginger
4. **Modern Technology of Vegetable Production**
- 4.1. Application of tissue culture and bio-technology in agriculture
  - 4.2. Use of plant growth regulators in vegetables
  - 4.3. Technique of irrigation for efficient use of water
  - 4.4. Micro-nutrient, multi-nutrient, liquid fertilizers and bio-fertilizers
  - 4.5. Latest recommended superior hybrids and superior open pollinated cultivars used by Nepali farmers
  - 4.6. Integrated disease and pest management (including biological method, cultural method, pheromone traps)
  - 4.7. Integrated soil and plant nutrient management
  - 4.8. Scope and limitation of using true potato seed in potato production
  - 4.9. Disease free seed potato production
  - 4.10. Plastic plug tray technology in vegetable seedlings production
5. **Plant Genetics and Variety Improvement**
- 5.1. Genes and their action: Mendelism, genotype and phenotype, homogygosity and heterogygosity, partial and complete dominance, genetic linkage
  - 5.2. Importance of variation
  - 5.3. Breeding methods: self-pollinated vegetables and cross-pollinated vegetables
  - 5.4. Concept of heterosis and hybrid variety development
  - 5.5. Mutation breeding
  - 5.6. Vegetable genetic resources and their conservation
6. **Vegetable Crop Physiology**
- 6.1. Photosynthesis
  - 6.2. Respiration
  - 6.3. Transpiration and translocation
  - 6.4. Photoperiodism, light intensity and quality
  - 6.5. Growth and development: cell division, enlargement and differentiation

## **B : Fruit**

1. **General Principles and Practices of Fruit Production**
  - 1.1 Suitable site, climate and soil requirement for fruit crops
  - 1.2 Orchard design, layout, planting and management during orchard establishment
  - 1.3 Plant Propagation and nursery management in fruit crops
  - 1.4 Production of fruit plants - sexual & asexual methods for tropical, sub-tropical and temperate climates
  - 1.5 Training, pruning and top-working in fruit trees
  - 1.6 Protection of nursery and fruit trees from diseases, pests and adverse conditions

- 1.7 Water management in orchard
  - 1.8 Nutrient management in orchard
  - 1.9 Fruit drop problem management
  - 1.10 High density planting of orchard
2. **Fruit Production Technique**
- 2.1 Production technology of major tropical, sub-tropical and temperate fruits (mango, litchi, guava, banana, papaya, jackfruit, sapato, pineapple, grape, straw berry, mandarin orange, sweet orange, lime, Lemon, apple, pear, peach, plum, kiwi fruit and walnut) on following aspects:  
(a) Introduction (b) Origin and distribution (c) botany (d) climate and soil (e) varieties (f) propagation (g) planting (h) irrigation and drainage (i) manuring (j) weeding (k) training and pruning (l) inter culture (m) diseases and insect pests (n) harvesting
  - 2.2 Wild and indigenous fruits in Nepal
3. **Fruit Variety Development**
- 3.1 Reproductive system of fruit crops
  - 3.2 Breeding methods in fruit crops
  - 3.3 Application of bio-technology and tissue culture in fruit crops
  - 3.4 Maintenance of fruit varieties
4. **Scope and potentiality of new emerging fruit crops; Avocado, Dragon fruit, Berry**

**C : Flower**

1. Status, importance and opportunity of floriculture in Nepal
2. Cultivation practices of major cut flowers in Nepal
3. Cutflower and ornamental plants cultivation under protected structure

**D : Other General Topics**

**1 Horticultural Crops Physiology**

- 1.1 Photosynthesis
- 1.2 Transpiration and translocation
- 1.3 Respiration
- 1.4 Photoperiodism, light intensity and quality
- 1.5 Growth and development: cellular division, enlargement and differentiation
- 1.6 Plant growth hormones
- 1.7 Use of plant growth regulators in horticultural crops

- 2. Postharvest Handling, Processing and Marketing of Horticultural Crops**
  - 2.1 Post harvest physiology- respiration, transpiration and ethylene production
  - 2.2 Method of harvesting, cleaning, grading, and packaging of horticultural crops
  - 2.3 Post harvest handling, transportation and marketing of horticultural crops
  - 2.4 Consumer's acceptability and quality evaluation
  - 2.5 Processing and preservation of horticultural crops
  
- 3. Research Method and Management**
  - 3.1 Research needs in fruit and vegetable crops
  - 3.2 Steps in research project proposal preparation
  - 3.3 Design of experiments and its basic characters
  - 3.4 Implementation of research activities
  - 3.5 Laboratory research
  - 3.6 On-station research
  - 3.7 On farm research
  - 3.8 Outreach research
  - 3.9 Farmer's participatory research
  - 3.10 Collaborative research
  - 3.11 Multi-partnership research
  - 3.12 Data collection
  - 3.13 Data analysis, technical report writing and presentation
  
- 4. Statistics**
  - 4.1 Basic statistics: Mean, mode, median, standard deviation, variances, f-test, t-test and chi-square test
  - 4.2 Experimental designs: Complete randomized design, randomized complete block design, Latin square design, split plot design
  - 4.3 Two or more factorial experiment: randomization, layout and data analysis
  - 4.4 Analysis of variance
  - 4.5 Data transformation
  - 4.6 Comparison: pair comparison by Least Significant Different (LSD) and Duncan's Multiple Range Test (DMRT)
  - 4.7 Correlation and regression

4.8 Need of biological statistics for research

**5. Research Methods and Management**

5.1 Research needs in horticultural crops

5.2 Steps in research project proposal preparation

5.3 Design of experiments and its basic characters

5.4 Implementation of research activities

5.5 Laboratory research

5.6 On-station research

5.7 On-farm research

5.8 Outreach research

5.9 Data base preparation

5.10 Data analysis, technical report writing and presentation

**6. Biological Statistics**

6.1 Need of biological statistics for vegetable research

6.2 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

6.3 Estimate of error: replication and randomization

6.4 Control error: blocking, proper plot technique and data analysis

6.5 Complete randomized design: randomization, layout and analysis of variance

6.6 Randomized complete block design: layout, randomization, analysis of variance

6.7 Two or more factorial experiment: randomization, layout, analysis of variance and interaction

6.8 Split plot design: randomization, analysis of variance and interaction of factors

6.9 Comparison: pair comparison by Least Significant Difference (LSD) and Duncan's Multiple Range Test (DMRT)

6.10 Regression and correlation: simple linear regression and correlation, multiple-linear regression and correlation

**7. Others**

7.1 Classification of horticultural crops

7.2 Major horticultural crops in Nepal

7.3 Importance and scope of horticulture in Nepal

7.4 History of horticultural research and development plans and programs in Nepal

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नेपाल कृषि अनुसन्धान परिषद्  
पदपूर्ति समिति

- 7.5 Main constraints to fruit research and production in Nepal
- 7.6 History, objective, role and activities of Nepal Agricultural Research Council (NARC)
- 7.7 Role of National Horticulture Research Center in technology and variety development of vegetables
- 7.8 Agriculture Research Stations involved in horticultural research activities
- 7.9 Importance of seed act and plant quarantine in horticulture development
- 7.10 Fruit saplings production and distribution system in Nepal
- 7.11 Importance of nursery and plant quarantine in horticulture development

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NARC पदपूर्ति समिति



प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), ओलरिकल्चर/पोमोलोजी उपसमूहको खुला तथा  
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

## **Paper-II**

### **Technical Subject**

#### **A : Olericulture**

##### **1. Vegetable Production**

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

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

##### **2. Off-Season Vegetable Production**

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

##### **3. Seed Production Technology**

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

- 3.5. Techniques of quality control in vegetable seed production
  - 3.6. Breeder, nucleus and foundation seed production in vegetable
  - 3.7. Seed production methods for open pollinated and hybrid cultivars
  - 3.8. Pre-basic, basic and improved/certified seed production in potato and ginger
4. **Modern Technology of Vegetable Production**
- 4.1. Application of tissue culture and bio-technology in agriculture
  - 4.2. Use of plant growth regulators in vegetables
  - 4.3. Technique of irrigation for efficient use of water
  - 4.4. Micro-nutrient, multi-nutrient, liquid fertilizers and bio-fertilizers
  - 4.5. Latest recommended superior hybrids and superior open pollinated cultivars used by Nepali farmers
  - 4.6. Integrated disease and pest management (including biological method, cultural method, pheromone traps)
  - 4.7. Integrated soil and plant nutrient management
  - 4.8. Scope and limitation of using true potato seed in potato production
  - 4.9. Disease free seed potato production
  - 4.10. Plastic plug tray technology in vegetable seedlings production
5. **Plant Genetics and Variety Improvement**
- 5.1. Genes and their action: Mendelism, genotype and phenotype, homogygosity and heterogygosity, partial and complete dominance, genetic linkage
  - 5.2. Importance of variation
  - 5.3. Breeding methods: self-pollinated vegetables and cross-pollinated vegetables
  - 5.4. Concept of heterosis and hybrid variety development
  - 5.5. Mutation breeding
  - 5.6. Vegetable genetic resources and their conservation
6. **Vegetable Crop Physiology**
- 6.1. Photosynthesis
  - 6.2. Respiration
  - 6.3. Transpiration and translocation
  - 6.4. Photoperiodism, light intensity and quality
  - 6.5. Growth and development: cell division, enlargement and differentiation

## **B : Pomology**

### **1. General Principles and Practices of Fruit Production**

- 1.1 Suitable site, climate and soil requirement for fruit crops
- 1.2 Orchard design, layout, planting and management during orchard establishment
- 1.3 Plant Propagation and nursery management in fruit crops
- 1.4 Production of fruit plants - sexual & asexual methods for tropical, sub-tropical and temperate climates
- 1.5 Training, pruning and top-working in fruit trees
- 1.6 Protection of nursery and fruit trees from diseases, pests and adverse conditions

- 1.7 Water management in orchard
  - 1.8 Nutrient management in orchard
  - 1.9 Fruit drop problem management
  - 1.10 High density planting of orchard
2. **Fruit Production Technique**
- 2.1 Production technology of major tropical, sub-tropical and temperate fruits (mango, litchi, guava, banana, papaya, jackfruit, sapato, pineapple, grape, straw berry, mandarin orange, sweet orange, lime, Lemon, apple, pear, peach, plum, kiwi fruit and walnut) on following aspects:  
(b) Introduction (b) Origin and distribution (c) botany (d) climate and soil (e) varieties (f) propagation (g) planting (h) irrigation and drainage (i) manuring (j) weeding (k) training and pruning (l) inter culture (m) diseases and insect pests (n) harvesting
  - 2.2 Wild and indigenous fruits in Nepal
3. **Fruit Variety Development**
- 3.1 Reproductive system of fruit crops
  - 3.2 Breeding methods in fruit crops
  - 3.3 Application of bio-technology and tissue culture in fruit crops
  - 3.4 Maintenance of fruit varieties
4. **Scope and potentiality of new emerging fruit crops; Avocado, Dragon fruit, Berry**

**D : Other General Topics**

**1 Horticultural Crops Physiology**

- 1.1 Photosynthesis
- 1.2 Transpiration and translocation
- 1.3 Respiration
- 1.4 Photoperiodism, light intensity and quality
- 1.5 Growth and development: cellular division, enlargement and differentiation
- 1.6 Plant growth hormones
- 1.7 Use of plant growth regulators in horticultural crops

**2. Postharvest Handling, Processing and Marketing of Horticultural Crops**

- 2.1 Post harvest physiology- respiration, transpiration and ethylene production
- 2.2 Method of harvesting, cleaning, grading, and packaging of horticultural crops
- 2.3 Post harvest handling, transportation and marketing of horticultural crops

- 2.4 Consumer's acceptability and quality evaluation
- 2.5 Processing and preservation of horticultural crops

### **3. Research Method and Management**

- 3.1 Research needs in fruit and vegetable crops
- 3.2 Steps in research project proposal preparation
- 3.3 Design of experiments and its basic characters
- 3.4 Implementation of research activities
- 3.5 Laboratory research
- 3.6 On-station research
- 3.7 On farm research
- 3.8 Outreach research
- 3.9 Farmer's participatory research
- 3.10 Collaborative research
- 3.11 Multi-partnership research
- 3.12 Data collection
- 3.13 Data analysis, technical report writing and presentation

### **4. Statistics**

- 4.1 Basic statistics: Mean, mode, median, standard deviation, variances, f-test, t-test and chi-square test
- 4.2 Experimental designs: Complete randomized design, randomized complete block design, Latin square design, split plot design
- 4.3 Two or more factorial experiment: randomization, layout and data analysis
- 4.4 Analysis of variance
- 4.5 Data transformation
- 4.6 Comparison: pair comparison by Least Significant Different (LSD) and Duncan's Multiple Range Test (DMRT)
- 4.7 Correlation and regression
- 4.8 Need of biological statistics for research

### **5. Research Methods and Management**

- 5.1 Research needs in horticultural crops
- 5.2 Steps in research project proposal preparation

- 5.3 Design of experiments and its basic characters
- 5.4 Implementation of research activities
- 5.5 Laboratory research
- 5.6 On-station research
- 5.7 On-farm research
- 5.8 Outreach research
- 5.9 Data base preparation
- 5.1. Data analysis, technical report writing and presentation

## 6. **Biological Statistics**

- 6.1 Need of biological statistics for vegetable research
- 6.2 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
- 6.3 Estimate of error: replication and randomization
- 6.4 Control error: blocking, proper plot technique and data analysis
- 6.5 Complete randomized design: randomization, layout and analysis of variance
- 6.6 Randomized complete block design: layout, randomization, analysis of variance
- 6.7 Two or more factorial experiment: randomization, layout, analysis of variance and interaction
- 6.8 Split plot design: randomization, analysis of variance and interaction of factors
- 6.9 Comparison: pair comparison by Least Significant Difference (LSD) and Duncan's Multiple Range Test (DMRT)
- 6.10 Regression and correlation: simple linear regression and correlation, multiple-linear regression and correlation

## 7. **Others**

- 7.1 Classification of horticultural crops
- 7.2 Major horticultural crops in Nepal
- 7.3 Importance and scope of horticulture in Nepal
- 7.4 History of horticultural research and development plans and programs in Nepal
- 7.5 Main constraints to fruit research and production in Nepal
- 7.6 History, objective, role and activities of Nepal Agricultural Research Council (NARC)

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- 7.7 Role of National Horticulture Research Center in technology and variety development of vegetables
- 7.8 Agriculture Research Stations involved in horticultural research activities
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- 7.10 Fruit saplings production and distribution system in Nepal
- 7.11 Importance of nursery and plant quarantine in horticulture development

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NARC पदपूर्ति समिति

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## **Paper-II**

### **Technical Subject** **Sub-Group: Pomology**

#### **1. General Principles and Practices of Fruit Production**

- 1.1 Suitable site, climate and soil requirement for fruit crops
- 1.2 Orchard design, layout, planting and management during orchard establishment
- 1.3 Plant Propagation and nursery management in fruit crops
- 1.4 Production of fruit plants - sexual & asexual methods for tropical, sub-tropical and temperate climates
- 1.5 Training, pruning and top-working in fruit trees
- 1.6 Protection of nursery and fruit trees from diseases, pests and adverse conditions
- 1.7 Water management in orchard
- 1.8 Nutrient management in orchard
- 1.9 Fruit drop problem management
- 1.10 High density planting of orchard

#### **2. Fruit Crops Physiology**

- 2.1 Photosynthesis
- 2.2 Transpiration and translocation
- 2.3 Respiration
- 2.4 Photoperiodism, light intensity and quality
- 2.5 Growth and development: cellular division, enlargement and differentiation
- 2.6 Plant growth hormones
- 2.7 Use of plant growth regulators in horticultural crops

#### **3. Fruit Production Technique**

- 3.1 Production technology of major tropical, sub-tropical and temperate fruits (mango, litchi, guava, banana, papaya, jackfruit, sapota, pineapple, grape, strawberry, mandarin orange, sweet orange, lime, Lemon, apple, pear, peach, plum, kiwi fruit and walnut) on following aspects:  
(a) Introduction (b) Origin and distribution (c) botany (d) climate and soil (e) varieties (f) propagation (g) planting (h) irrigation and drainage (i) manuring (j) weeding (k) training and pruning (l) inter culture (m) diseases and insect pests (n) harvesting
- 3.2 Wild and indigenous fruits in Nepal

#### **4. Fruit Variety Development**

- 4.1 Reproductive system of fruit crops
- 4.2 Breeding methods in fruit crops

- 4.3 Application of bio-technology and tissue culture in fruit crops
- 4.4 Maintenance of fruit varieties
5. **Scope and potentiality of new emerging fruit crops; Avocado, Dragon fruit, Berry**
6. **Postharvest Handling, Processing and Marketing of Fruit**
  - 6.1 Post harvest physiology- respiration, transpiration and ethylene production
  - 6.2 Method of harvesting, cleaning, grading, and packaging of fruit
  - 6.3 Post harvest handling, transportation and marketing of fruit
  - 6.4 Consumer's acceptability and quality evaluation
  - 6.5 Processing and preservation of fruit
7. **Research Method and Management**
  - 7.1 Research needs in fruit
  - 7.2 Steps in research project proposal preparation
  - 7.3 Design of experiments and its basic characters
  - 7.4 Implementation of research activities
  - 7.5 Laboratory research
  - 7.6 On-station research
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  - 7.12 Data collection
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  - 8.1 Basic statistics: Mean, mode, median, standard deviation, variances, f-test, t-test and chi-square test
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  - 8.5 Data transformation
  - 8.6 Comparison: pair comparison by Least Significant Different (LSD) and Duncan's Multiple Range Test (DMRT)
  - 8.7 Correlation and regression
  - 8.8 Need of biological statistics for research
9. **Other**
  - 9.1 Importance and scope of horticulture in Nepal
  - 9.2 History of horticultural research and development in Nepal
  - 9.3 Fruit saplings production and distribution system in Nepal



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- 9.4 Main constraints to fruit research and production in Nepal
- 9.5 Importance of nursery and plant quarantine in fruit development
- 9.6 Classification of horticultural crops
- 9.7 Role of Horticulture Research Division and research stations in Fruit Research and Development in NARC

NARC पदपूर्ति समिति

प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), ओलोरिकल्चर उपसमूहको खुल्ला तथा आन्तरिक  
प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**  
**Sub-Group: Olericulture**

**1. Vegetable Production**

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

- 1.1. Potato, sweet potato, yam, colocasia
- 1.2. Tomato, brinjal, hot chilly, sweet pepper
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- 1.5. Radish, turnip and carrot
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- 1.7. Cucumber, bottle gourd, sponge gourd, bitter gourd, pointed gourd, ridge gourd, snake gourd, pumpkin and squash
- 1.8. Broad leaf mustard, Swiss chard, cress, spinach, fenugreek, coriander, and lettuce
- 1.9. Ginger and cardamom
- 1.10. Asparagus, drumstick and tree tomato

**2. Off-Season Vegetable Production**

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

**3. Seed Production Technology**

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

- 3.5. Techniques of quality control in vegetable seed production
  - 3.6. Breeder, nucleus and foundation seed production in vegetable
  - 3.7. Seed production methods for open pollinated and hybrid cultivars
  - 3.8. Pre-basic, basic and improved/certified seed production in potato and ginger
4. **Post-harvest Technology of Vegetables**
- 4.1. Post-harvest physiology: respiration, transpiration and ethylene production
  - 4.2. Method of harvesting, cleaning, grading, and packaging
  - 4.3. Post-harvest handling, transportation and marketing
  - 4.4. Consumer's acceptability and quality evaluation of vegetables
  - 4.5. Processing and preservation of vegetables, potato, ginger and cardamom
5. **Modern Technology of Vegetable Production**
- 5.1. Application of tissue culture and bio-technology in agriculture
  - 5.2. Use of plant growth regulators in vegetables
  - 5.3. Technique of irrigation for efficient use of water
  - 5.4. Micro-nutrient, multi-nutrient, liquid fertilizers and bio-fertilizers
  - 5.5. Latest recommended superior hybrids and superior open pollinated cultivars used by Nepali farmers
  - 5.6. Integrated disease and pest management (including biological method, cultural method, pheromone traps)
  - 5.7. Integrated soil and plant nutrient management
  - 5.8. Scope and limitation of using true potato seed in potato production
  - 5.9. Disease free seed potato production
  - 5.10. Plastic plug tray technology in vegetable seedlings production
6. **Plant Genetics and Variety Improvement**
- 6.1. Genes and their action: Mendelism, genotype and phenotype, homogygosity and heterogygosity, partial and complete dominance, genetic linkage
  - 6.2. Importance of variation
  - 6.3. Breeding methods: self-pollinated vegetables and cross-pollinated vegetables
  - 6.4. Concept of heterosis and hybrid variety development
  - 6.5. Mutation breeding
  - 6.6. Vegetable genetic resources and their conservation
7. **Vegetable Crop Physiology**
- 7.1. Photosynthesis
  - 7.2. Respiration
  - 7.3. Transpiration and translocation
  - 7.4. Photoperiodism, light intensity and quality
  - 7.5. Growth and development: cell division, enlargement and differentiation
8. **Research Methods and Management**
- 8.1. Research needs in vegetable, potato and ginger
  - 8.2. Steps in research project proposal preparation
  - 8.3. Design of experiments and its basic characters

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- 8.4. Implementation of research activities
  - 8.5. Laboratory research
  - 8.6. On-station research
  - 8.7. On-farm research
  - 8.8. Outreach research
  - 8.9. Data base preparation
  - 8.10. Data analysis, technical report writing and presentation
9. **Biological Statistics**
- 9.1. Need of biological statistics for vegetable research
  - 9.2. Probability, frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling theory, test of hypothesis, and confidence interval, T-test, F-Test and Chi-square test
  - 9.3. Estimate of error: replication and randomization
  - 9.4. Control error: blocking, proper plot technique and data analysis
  - 9.5. Complete randomized design: randomization, layout and analysis of variance
  - 9.6. Randomized complete block design: layout, randomization, analysis of variance
  - 9.7. Two or more factorial experiment: randomization, layout, analysis of variance and interaction
  - 9.8. Split plot design: randomization, analysis of variance and interaction of factors
  - 9.9. Comparison: pair comparison by Least Significant Difference (LSD) and Duncan's Multiple Range Test (DMRT)
  - 9.10. Regression and correlation: simple linear regression and correlation, multiple-linear regression and correlation
10. **Others**
- 10.1. Importance and scope of horticulture in Nepal
  - 10.2. History of horticultural research and development plans and programs in Nepal
  - 10.3. Major horticultural crops in Nepal
  - 10.4. History, objective, role and activities of Nepal Agricultural Research Council (NARC)
  - 10.5. Role of Horticulture Research Division in technology and variety development of vegetables
  - 10.6. Agriculture Research Stations involved in horticultural research activities
  - 10.7. Importance of seed act and plant quarantine in vegetable development
  - 10.8. Classification of horticultural crops

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प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), एग्री एक्सटेन्शन एग्री ईकोनोमिक्स एण्ड मार्केटिङ: उपसमूहको खुल्ला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**

**Sub-Group: Agri Extension, Agri Economics and Marketing**

- 1. General Economic Theories**
  - 1.1 Consumer's preference Theory
  - 1.2 Demand curves and Engel curves
  - 1.3 Income and substitution effects
  - 1.4 Price, income and cross elasticity's of demand
  - 1.5 Classification of market and their critical appraisal
  - 1.6 Price determination in different market conditions
  - 1.7 Production function and principles of production
  - 1.8 Cost: concept and types
  - 1.9 Concept of opportunity cost, equilibrium, shadow prices and comparative and competitive advantages
- 2. Farm Business Analysis**
  - 2.1 Farm budgets
  - 2.2 Cost and return analysis of different crops
  - 2.3 Farm Plan
  - 2.4 Farm business analysis
- 3. Agricultural Marketing**
  - 3.1 Its concept and role in economic and agricultural development
  - 3.2 Structure and characters
  - 3.3 Problems and prospects
  - 3.4 Input and output marketing systems
  - 3.5 Agricultural marketing research-- concept and role
  - 3.6 Marketing information system in Nepal
  - 3.7 Co- operative marketing system in Nepal
  - 3.8 Food Security issues in Nepal
  - 3.9 Development and management of agricultural market centers
  - 3.10 Agricultural marketing and price policies in Nepal
  - 3.11 Regional and global organizations for marketing (SAFTA, WTO with emphasis on AoA)
- 4. Agribusiness**
  - 4.1 Concept, role
  - 4.2 Grading, packaging, standardization, situation and problems
  - 4.3 Input and output marketing

**5. Agricultural Planning**

- 5.1 Concept of planning, project, project cycle, programming and budgeting
- 5.2 Methods of conducting feasibility study ( BCR, NPV, IRR,)
- 5.3 Project analysis methods
- 5.4 Concept and methods of monitoring and evaluation
- 5.5 Concept and use of log frame
- 5.6 Participatory planning, monitoring and evaluation
- 5.7 Market -led agriculture development
- 5.8 Pocket package strategy and projectlization
- 5.9 Devolution of planning to local bodies
- 5.10 Environmental consideration in agricultural planning

**6. Socio-Economic Research**

- 6.1 Need and importance
- 6.2 Research methodology (PRA, Focus Group Discussion, Key Informant Interview)
- 6.3 Report writing

**7. Agricultural Finance and Organization**

- 7.1 Agricultural Finance: Role, Structure and Weaknesses
- 7.2 Role of Foreign Aid in agricultural development-Issues and prospects
- 7.3 Organizational development in agriculture

**8. Statistics**

- 8.1 Measures of central tendency- Mean, Median, Mode
- 8.2 Measures of dispersion- quartile deviation, range, variance, mean and standard variation
- 8.3 Probability: normal distribution, standard sampling error and test of hypothesis, estimate of error
- 8.4 Correlation and regression- simple linear regression and correction
- 8.5 Simple & weighted index number

**9. Others**

- 9.1 Role of agriculture in poverty alleviation and economic development of Nepal
- 9.2 Problems and prospects of agricultural research and development in Nepal
- 9.3 Farming System in Nepal

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## **Paper-II**

### **Technical Subject** **Sub-Group: Entomology**

#### **1. Introductory Entomology:**

- 1.1 Role of entomology in agriculture
- 1.2 Scope of entomological research in agriculture
- 1.3 Insects and their relatives
- 1.4 General structure of a typical insect
- 1.5 General metamorphosis and life cycle of Lepidoptera, Coleoptera and Hemiptera
- 1.6 Pest insects and beneficial insects

#### **2. Agricultural insect pests, their identification, damage symptom/s in crop, their life cycle and field management:**

- 2.1 Cereal crops: White-, stripped-and pink-borer, green leafhoppers, brown planthopper, hispa, gandhi bug, white grub, aphid, shoot fly, mealy bug, leafroller, armyworms
- 2.2 Grain legumes: Gram pod borer, pod fly, pod borer, aphids, whitefly, leaf miner, stem fly, hairy caterpillar, cutworm
- 2.3 Oilseed crops: Termite, red ant, white grub, hairy caterpillar, aphids, mites.
- 2.4 Industrial crops: Cutworm, white grub, termite, hairy caterpillar, tobacco caterpillar, gram pod borer, top shoot borer, shoot borer, pink bollworm, spiny bollworm, mealy bug, pyrilla, red cotton bug, leaf hoppers, whiteflies, aphids, mites

#### **3. Horticultural insect pests, their identification, damage symptom/s in crop, their life cycle and field management:**

- 3.1 Vegetables: Cutworm, red ant, white grub, cabbage butterfly, diamondback moth, tobacco caterpillar, gram pod borer, epilachna beetles, fruit fly, whitefly, flea beetles, aphids, egg plant shoot and fruit borer, mites.
- 3.2 Potato: Cutworm, red ant, peach-potato aphid, white grub, epilachna beetles, potato tuber moth
- 3.3 Fruit trees: Cutworm, termite, leaf roller, bark eating caterpillar, tent caterpillar, hairy caterpillar, leaf miner, fruit fly, stone weevil, banana weevil, root borer, lemon butterfly, pomegranate butterfly, mango leaf hoppers, mango gall midge, mango gall psyllid, mealy bug, aphids, citrus psyllid, scale insects, thrips, mites.
- 3.4 **Tea, coffee and cardamom:** Aphids, white grub, tea mosquito. White and red stem borer of coffee.

**4. Post Harvest Entomology:**

- 4.1 Grain weevils, beetles and moths in stored grains, their identification and damage symptom
- 4.2 Life-cycle of *Sitophilus oryzae* in wheat and *Sitotroga cereallela* in maize
- 4.3 Stored insect pests control methods
  - 4.3.1 Non-chemical methods
  - 4.3.2 Chemical methods

**5. Industrial Entomology:**

**5.1 Apiculture**

- 5.1.1 Different kinds of honeybees and their identifications
- 5.1.2 Common typical nature of honeybees
- 5.1.3 Life-cycle of honeybees and brood rearing
- 5.1.4 Honeybee members in a typical apiary and their division of labour
- 5.1.5 Insect pests and diseases commonly found in an apiary and their management for the quality honey production.
- 5.1.6 Insecticide poisoning of honeybees and methods to deter it.
- 5.1.7 Nature and properties of honey
- 5.1.8 Different hives, favourite honeybee species and modern apiculture
- 5.1.9 Scope of commercial apiculture in Nepal

**5.2 Sericulture**

- 5.2.1 Different types of silkworms
- 5.2.2 Life-cycle of *Bombax mori*
- 5.2.3 Rearing techniques
- 5.2.4 Diseases in silkworm and practices to avoid them
- 5.2.5 Use of mulberry and their cultivation

**6. Rodents and their Management p\Practices:**

- 6.1 Different kinds of rats and mice in grain storage and in the standing crops
- 6.2 Typical nature of rats and mice
- 6.3 Damage and losses of grains and crops due to rats and mice
- 6.4 Methods of rodent management.

**7. Insect-Pest Management in Cultivated Crops:**

- 7.1 Use of cultivation practices
- 7.2 Use of mechanical methods
- 7.3 Use of physical methods
- 7.4 Use of insecticides of chemical and botanical origins
- 7.5 Use of natural enemies
- 7.6 Use of chemical attractants, repellants, sterilants and growth inhibitors
- 7.7 Use of insect resistant varieties of crops.
- 7.8 Use of quarantine
- 7.9 Integrated pest management practice



**8. Insecticide and Plant Protection Equipment Management:**

- 8.1 General classification of insecticides based on chemical nature, mode of entry and mode of action.
- 8.2 Formulation of insecticides
- 8.3 Dose calculation
- 8.4 Sprayer calibration
- 8.5 Safe handling of insecticides
- 8.6 Avoidance of poisoning of non-target organisms
- 8.7 Types of sprayers and dusters
- 8.8 Parts of a hand compression knapsack sprayer and their functions
- 8.9 Care and maintenance of a sprayer

**9. Entomological Laboratory Techniques:**

- 9.1 Insect collection and preservation
  - 9.1.1 Insect collection equipments and their uses
  - 9.1.2 Dry and wet preservation of insects and materials used for the purpose.
- 9.2 Simple methods of laboratory rearing of insects
  - 9.2.1 Measuring devices of temperature and humidity inside the laboratory
  - 9.2.2 Glasswares, plastic/metal containers and wooden cages
  - 9.2.3 Chemicals and ready-made compounds to fix cages
  - 9.2.4 Feeding materials to laboratory reared insects. Formulation of artificial diet.

**10. Statistics:**

- 10.1 Basic statistics: Mean, mode, median, standard deviation, variances, f-test, t-test and chi-square test
- 10.2 Experimental designs: Complete randomized design, randomized complete block design, Latin square design, split plot design
- 10.3 Two or more factorial experiment: randomization, layout and data analysis.
- 10.4 Analysis of variance
- 10.5 Data transformation
- 10.6 Comparison:- pair comparison by Least Significant Different (LSD) and Duncan's Multiple Range Test (DMRT)
- 10.7 Correlation and regression
- 10.8 Need of biological statistics for research

प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), एग्रो मेटेरियोलोजी उपसमूहको

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**Paper-II**

**Technical Subject**  
**Sub-Group: Agro Meteorology**

**1. Meteorology**

- 7.1 Composition of the atmosphere
- 7.2 Weather elements
- 7.3 Precipitation
- 7.4 Temperature
- 7.5 Relative humidity
- 7.6 Wind
- 7.7 Sunshine
- 7.8 Global radiation
- 7.9 Dew

**2. Climatology**

- 2.1 Definition and scope of climatology
- 2.2 Climatic classification of Nepal
- 2.3 Thornwaite and koppen's classification
- 2.4 Monsoon and annual rainfall

**3. Introduction to Agro-Meteorology**

- 3.1 Definition of weather and climate
- 3.2 Agro climate
- 3.3 Weather problem in farming

**4. Plant and Agro Climatic Studies**

- 4.1 Growth factor and yield of a plant
- 4.2 Growth studies

**5. Radiation, Temperature and Light**

- 5.1 Solar energy
- 5.2 Heat budget
- 5.3 Air temperature
- 5.4 Soil temperature
- 5.5 Slope effect

## **6. Temperature and Plant**

- 6.1 Cardinal temperature
- 6.2 Heat tolerance crop
- 6.3 High temperature effect
- 6.4 Low temperature effect
- 6.5 Thermo sensitive plant
- 6.6 Photosensitive plant

## **7. Sunshine and Light**

- 10.1 Sunshine intensity
- 10.2 Light intensity
- 10.3 Day length and light intensities

## **8. Precipitation**

- 8.1 Hydrologic cycle
- 8.2 Monsoon rainfall
- 8.3 Rainfall distribution
- 8.4 Rainfall variability
- 8.5 Rainfall intensity
- 8.6 Rainfall frequency

## **9. Rainfall Effect**

- 9.1 Excessive rain
- 9.2 Effective rainfall

## **10. Drought**

- 12.1 Definition of drought
- 12.2 Kinds of drought

## **11. Moisture**

- 11.1 Humid
- 11.2 Evaporation
- 11.3 Evapotranspiration
- 11.4 Soil moisture
- 11.5 Water evaporation from soil
- 11.6 Water budget

## **12. Wind**

- 14.1 Wind effect controlling
- 14.2 Local wind

## **13. Agricultural Relationship of Climate**

- 13.1 Effect of climate on soil
- 14.3 Effect of climate on plant and disease

**14. Climate Change:**

- 14.1 Defination and scope
- 14.2 Atmospheric composition and its changes
- 14.3 Green house effects and anthropogenic influences
- 14.4 National policy on climate change
- 14.5 Variation of climate in Nepal
- 14.6 Adoptation and metigation

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प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), बायोटेक्नोलोजी उपसमूहको  
खुल्ला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**  
**Sub-Group: Biotechnology**

**1. DNA Technologies**

- 1.1 Nucleic acid structure, chemical and physical properties of nucleic acid, DNA supercoiling, RNAs (rRNA, tRNA, mRNA), Genetic code
- 1.2 Replication: Eukaryotic and Prokaryotic
- 1.3 DNA damage, repair and recombination
- 1.4 DNA cloning and cloning vectors
- 1.5 Application of DNA technology in agriculture

**2. Laboratory Procedures**

- 2.1 Biosafety rules and standard operating procedures (SOPs) of Biotechnology Laboratory
- 2.2 Calculation of molecular ions and weight in reagent and buffer preparations
- 2.3 Different types of media preparations in aseptic conditions
- 2.4 Tissue culture methodologies
- 2.5 DNA isolation, Quantification of Nucleic acid, PCR
- 2.6 Gel electrophoresis and gel analysis
- 2.7 Genetic analysis using computer software (MSTAT, Gen STAT)

**3. Tissue Culture**

- 3.1 Historical prospective
- 3.2 Media: composition, preparation, aseptic manipulation of in vitro cultures
- 3.3 Cell cultures: method, types of suspension culture, cell synchronization
- 3.4 Somatic hybridization and protoplast culture and protoplast fusion
- 3.5 Haploid production through anthers and ovary and its application in plant breeding, problems associated with haploid production
- 3.6 Embryo culture and its practical applications
- 3.7 Somaclonal variation and its application in plant breeding
- 3.8 Meristem-tip culture
- 3.9 Clonal propagation or micropropagation: stages, multiplication by axillary and apical shoots, adventitious shoots, callus culture, factors affecting in vitro rooting, acclimatization of plants transferred to soil, technical problems in micropropagation, application of micropropagation
- 3.10 In vitro preservation of plant material, cryopreservation and freeze preservation

**4. Statistics**

- 4.1 Measures of central tendency- Mean, Median, Mode
- 4.2 Measures of dispersion- quartile deviation, range, variance, mean and standard variation
- 4.3 Probability: normal distribution, standard sampling error and test of hypothesis, estimate of error

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- 4.4 Correlation and regression-simple linear regression and correction
- 4.5 Simple and weighted index number

**5. Others**

- 5.1 Prospective of Biotechnology in Nepal
- 5.2 Biochemistry: Macromolecules and their properties, biosynthesis of macromolecules, central metabolic pathways (Calvin-Benson cycle, Glycolysis, Kreb's cycle, Electron Transport System)

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प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), प्लाण्ट प्याथोलोजी उपसमूहको  
खुल्ला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**  
**Sub-Group: Plant Pathology**

**1. Introduction**

- 1.1 Importance of plant diseases to human beings
- 1.2 Role of plant pathology in agriculture
- 1.3 Various terminologies in plant pathology
- 1.4 History of plant pathology
- 1.5 Climate change and its implication on plant diseases
- 1.6 Causes of plant diseases:
  - 1.6.1 Biotic: Fungi, bacteria, viruses, mycoplasma, nematodes
  - 1.6.2 Abiotic: Deficiencies and environment-related disorders

**2. Plant Diseases of National Importance and their Management**

- 2.1 Rice:
  - 2.1.1 Rice Blast (*Magnaporthe grisea*)
  - 2.1.2 Bacterial blight (*Xanthomonas oryzae* pv. *oryzae*)
  - 2.1.3 Sheath blight (*Rhizoctonia solani*)
  - 2.1.4 Brown spot (*Helminthosporium oryzae*)
  - 2.1.5 Foot rot (*Fusarium moniliforme*)
- 2.2 Wheat:
  - 2.2.1 Foliar blight (*Bipolaris sorokiniana* and *Pyrenophora tritici-repentis*)
  - 2.2.2 Leaf Rust (*Puccinia triticina*)
  - 2.2.3 Stripe Rusts (*Puccinia striiformis*)
  - 2.2.4 Powdery mildew (*Erysiphe polygoni*)
  - 2.2.5 Bunt of Wheat (*Tilletia caries*, *Tilletia foetida*)
  - 2.2.6 Recent status of Stem rust and its management
- 2.3 Maize:
  - 2.3.1 Northern leaf blight (*Exserohilum turcicum*), Southern leaf blight (*Bipolaris maydis*)
  - 2.3.2 Stalk rot (*Erwinia carotovora*)
  - 2.3.3 Banded leaf and Sheath blight (*Rhizoctonia solani*)
  - 2.3.4 Ear rot (*Fusarium verticilloides*)
  - 2.3.5 Gray leaf spot (*Cercospora zea-maydis*)
- 2.4 Finger millet:
  - 2.4.1 Blast (*Pyricularia grisea*)
  - 2.4.2 Cercospora leaf spot (*Cercospora eleusine*)
- 2.5 Potato:
  - 2.5.1 Late blight of potato (*Phytophthora infestans*)
  - 2.5.2 Early blight (*Alternaria solani*)
  - 2.5.3 Bacterial wilt (*Ralstonia solanacearum*)
  - 2.5.4 Wart (*Synchytrium endobioticum*)

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- 2.5.5 Viral diseases (Potato virus X, Y)
- 2.6 Tomato:
- 2.6.1 Wilt (*Ralstonia solanacearum*)
- 2.6.2 Late blight (*Phytophthora infestans*)
- 2.6.3 Early blight (*Alternaria solani*)
- 2.6.4 Root-knot nematodes (*Meloidogyne* spp.)
- 2.7 Cruciferae:
- 2.7.1 Club root (*Plasmodiophora brassicae*)
- 2.7.2 Alternaria leaf spot (*Alternaria brassicae*)
- 2.7.3 Damping-off of seedlings (*Pythium*spp.,*Rhizoctonia* spp., *Fusarium*spp.etc)
- 2.7.4 Black rot (*Xanthomonas campestris* pv. *campestris*)
- 2.7.5 White rust (*Albugo candida*)
- 2.8 Cucurbits:
- 2.8.1 Powdery mildew (*Erysiphe cichoracearum*)
- 2.8.2 Downey mildew (*Peronospora cubensis*)
- 2.9 Pea nut:
- 2.9.1 Tikka disease (*Cercospora personata* and *Cercospora arachidicola*)
- 2.10 Lentil:
- 2.10.1 Wilt (*Fusarium oxysporum*)
- 2.10.2 Root rot (*Fusarium solani*)
- 2.10.3 Stemphylium blight
- 2.10.4 Gray mould (*Botrytis cinerea*)
- 2.11 Soybean:
- 2.11.1 Rust (*Phakopsora pachyrhizi*)
- 2.11.2 Anthracnose (*Colletotrichum glycines*)
- 2.11.3 Bacterial pustule (*Xanthomonas campestris* pv. *glycines*)
- 2.12 Sugarcane:
- 2.12.1 Red rot (*Colletotrichum falcatum*)
- 2.13 Citrus:
- 2.13.1 Huang lung bin/Greening (*Liberibacter asiaticum*)
- 2.13.2 Tristeza (CTV)
- 2.13.3 Citrus decline (disease complex)
- 2.13.4 Foot and root rots (*Phytophthora* spp.)
- 2.13.5 Pink disease (*Pellicularia salmonicolor*)
- 2.13.6 Canker
- 2.13.7 Scab (*Elsinoe fawcetti*)
- 2.13.8 Gummosis (*Phytophthora* spp.)
- 2.14 Apple and temperate fruit:
- 2.14.1 Scab (*Venturia inaequalis*)
- 2.14.2 Pink disease (*Pellicularia salmonicolor*)
- 2.14.3 Root rot (Complex)
- 2.14.4 Powdery mildew (*Oidium* spp.)
- 2.15 Mango:
- 2.15.1 Mango malformation (Complex)
- 2.15.2 Anthracnose (*Colletotrichum gloesporioides*)
- 2.16 Banana:
- 2.16.1 Wilt (*Fusarium* spp.)
- 2.16.2 Sigatoka leaf spot (*Mycosphaerella* spp.)



- 2.16.3 Bunchy top (Viral)
  - 2.17 Tea:
    - 2.17.1 Blister blight (*Exobasidium vexans*)
    - 2.17.2 Blight (*Pestalotia theae*)
  - 2.18 Coffee:
    - 2.18.1 Rust (*Hemileia vastatrix*)
  - 2.19 Caradamom
    - 2.19.1 Seedling rot
    - 2.19.2 Chhirke and Phoorke (Viral)
  - 2.20 Zinger:
    - 2.20.1 Rhizome rot (Complex)
- 3. Policy, Strategy, Rules and Regulation**
- 3.1 Pesticide Act, 2048 and pesticide Rules, 2050
  - 3.2 International Plant Protection Convention (IPPC) and Asia Pacific Plant Protection Commission (APPPC)
  - 3.3 Plant quarantine in view of WTO: Issues and challenges, importance in Nepalese agriculture trade, survey and surveillance, pest status, Pest Risk Analysis (PRA)
  - 3.4 WHO classification of pesticides by hazard
- 4. Seed Pathology**
- 4.1 Seed borne diseases and their significance
  - 4.2 Seed health testing techniques
  - 4.3 Seed treatment: equipments, methods, advantage and precaution
- 5. Plant Pathological Equipments**
- 5.1 Autoclave, Incubator, Laminar flow, Oven etc
  - 5.2 Types of Microscope and its uses
  - 5.3 Types of sprayers, duster, their Care and maintenance
  - 5.4 Safe handling of equipments and pesticides
- 6. Pathological Laboratory Techniques**
- 6.1 Disease (leaf/plant, pests, root, shoot, etc) sample collection and handling
  - 6.2 Preservation of disease sample
  - 6.3 Pathogen isolation, culture, purification, preservation and multiplication
  - 6.4 Sterilization and disinfection
  - 6.5 Pathogenicity test
  - 6.6 Different media, its preparation and uses
- 7. Pesticides**
- 7.1 Lethal dose (LD50) of a pesticide
  - 7.2 Symptoms and treatment of pesticide poisoning
  - 7.3 Pesticides uses and its impact on human health
  - 7.4 Recent status of pesticide uses in Nepal
  - 7.5 Assessment of pesticides residue in Nepal: status and prospects

## 8. Statistics

- 8.1 Basic statistics: Mean, mode, medium, standard deviation, variances, f-test, t-test and chi-square test.
- 8.2 Experimental designs: Complete randomized design, randomized complete block design, Latin square design, split plot design.
- 8.3 Analysis of variance
- 8.4 Comparison:- pair comparison by Least Significant Different (LSD) and Duncan's Multiple Range Test (DMRT)
- 8.5 Correlation and regression.

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प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), स्वायत्त साइन्स उपसमूहको खुल्ला तथा आन्तरिक  
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**Paper-II**

**Technical Subject**  
**Sub-Group: Soil Science**

- 1. Introduction to Soil Science**
  - 1.1 Definitions of soil
  - 1.2 Components of soil
- 2. Weathering and soil Formation**
  - 2.1 Weathering and soil forming processes
  - 2.2 Soil profile
  - 2.3 Soil horizons
- 3. Factors of Soil Formation**
- 4. Physical Properties of Soil**
  - 4.1 Mechanical analysis and soil texture
  - 4.2 Soil structure
  - 4.3 Importance of soil structure
  - 4.4 Density of soil
  - 4.5 Porosity of soil
  - 4.6 Soil consistence
  - 4.7 Soil colour
  - 4.8 Soil temperature
  - 4.9 Shrinkage and swelling of soils
- 5. Soil and Water**
  - 5.1 Infiltration
  - 5.2 Percolation
  - 5.3 Permeability
  - 5.4 Soil moisture constraints
- 6. Chemical Properties of Soil**
  - 6.1 Cation exchange
  - 6.2 Cation exchange capacity
  - 6.3 Base saturation
  - 6.4 Soil pH
  - 6.5 Soil pH and nutrient availability
  - 6.6 Reclamation of soil acidity and alkalinity

**7. Biological Properties of Soil**

- 7.1 Soil microorganisms
- 7.2 Classification of microorganisms
- 7.3 Amonification
- 7.4 Nitrification
- 7.5 Denitrification
- 7.6 Biological nitrogen fixation
- 7.7 Importance of nitrogen fixation
- 7.8 Soil organic matter
- 7.9 Carbon nitrogen ratio
- 7.10 Maintenance of soil organic matter

**8. Soil Chemical Analysis**

- 8.1 Methods of soil analysis
- 8.2 Importance of soil analysis

**9. Soil Survey and Classification**

- 9.1 Soil survey methods
- 9.2 General soil classification
- 9.3 Soils of Nepal
- 9.4 Geographic Information System (GIS), remote sensing and soil mapping

**10. Soil and Water Conservation**

- 10.1 Causes of soil erosion
- 10.2 Problems of soil erosion in Nepal
- 10.3 Methods of soil conservation
- 10.4 Importance of soil and water conservation

**11. Soil Fertility Management**

- 11.1 Soil fertility status
- 11.2 Plant nutrients
- 11.3 Functions of plant nutrients
- 11.4 Nutrient deficiencies
- 11.5 Chemical fertilizers
- 11.6 Organic fertilizers
- 11.7 Importance of fertilizer use

**12. Statistics**

- 12.1 Frequency, mean, median, mode, standard deviation, standard error, normal distribution, smapling methods, methods of hypothesis testing
- 12.2 Design of field experiments
- 12.3 Analysis of variance
- 12.4 Regression and correlation (simple linear regression and correlation)

**13. Others**

- 1.1 Nepal Agricultural Research Council: organization, objectives, role and activities
- 1.2 Research stations and their research activities
- 1.3 Constraints for agricultural research and production in Nepal

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**Paper-II**

**Technical Subject**

**Sub-Group: Agri-Engineering**

**1. Soil and Water Engineering**

**1.1 Irrigation Water Measurement Methods**

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

**1.2 Water Conveyance and Control**

- 1.2.1 Open channel
- 1.2.2 Design of open channel
- 1.2.3 Channel linings
- 1.2.4 Drop structures and spill ways
- 1.2.5 Water control and diversion structures
- 1.2.6 Pipe flow
- 1.2.7 Design of pipe conveyance system

**1.3 Land Development**

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

**1.4 Soil-Plant and Water Relationships and Irrigation Requirements**

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

**1.5 Water Application Methods**

- 1.5.1 Border irrigation
- 1.5.2 CheckBasin irrigation
- 1.5.3 Furrow Irrigation

1.5.4 Sprinkler Irrigation

1.5.5 Drip Irrigation

**1.6 Agricultural Drainage**

1.6.1 Surface drainage system

1.6.2 Subsurface drainage system

1.6.3 Type of drainage system

**1.7 Ground Water and Irrigation Wells**

1.7.1 Ground water and aquifers

1.7.2 Hydraulics of wells

1.7.3 Design of wells

1.7.4 Wells construction procedures

**1.8 Irrigation Pumps**

1.8.1 Indigenous water lifting devices

1.8.2 Positive displacement pumps

1.8.3 Centrifugal Pumps

1.8.4 Vertical Turbine Pumps

1.8.5 Submersible Pumps

1.8.6 Propeller and mixed flow pumps

1.8.7 Selection of pumps

**1.9 Engineering Hydrology**

1.9.1 Hydrological cycle

1.9.2 Measurement and analysis of precipitation

1.9.3 Measurement, estimation and analysis of runoff

1.9.4 Storm hydrograph

**1.10 Water Erosion and Control Measures**

1.10.1 Water erosion (Raindrop erosion, Sheet erosion, Rill erosion, Gully erosion, Stream channel erosion)

1.10.2 Soil losses and its measurement

1.10.3 Erosion control measures (agricultural, engineering, bioengineering methods)

1.10.4 Conservation structures

1.10.5 Watershed management

**2. Farm Power and Machinery**

**2.1 Farm Power and Energy**

2.1.1 Human power

2.1.2 Animal Power

2.1.3 Mechanical power

2.1.4 Electrical power

2.1.5 Solar and wind energy

## **2.2 Biomass Energy Internal Combustion Engines**

2.2.1 Petrol and diesel engines

2.2.2 Engine Parts

2.2.3 Principle of operation

2.2.4 Engine systems (air cleaning, fuel, lubricating, ignition, cooling, governing system)

## **2.3 Farm Tractor and its Operation and Maintenance**

2.3.1 Farm tractor types and selection

2.3.2 Parts and components of farm tractor (engine systems, clutch, power transmission, differentials, final drive, power take off, tractor draw bar and traction devices, steering mechanism, hydraulic system, starting mechanism)

2.3.3 Tractor repair and maintenance

## **2.4 Tillage and Tillage Implements**

2.4.1 Tillage requirements of crops

2.4.2 Tillage implements

2.4.3 Traditional animal drawn plough

2.4.4 Mold board plough

2.4.5 Disc plough

2.4.6 Chisel plough

2.4.7 Rotovator

2.4.8 Harrows

2.4.9 Minimum and zero tillage implements

2.4.10 Draft requirement of farm implements

2.4.11 Testing and selection of tillage implements

2.4.12 Operation and maintenance of tillage implements

## **2.5 Seeding, Harvesting and Threshing Machinery**

2.5.1 Sowing methods of major crops

2.5.2 Seed drill and its components

2.5.3 Planters and its components

2.5.4 Rice transplanters

2.5.5 Vertical conveyor reaper and its components

2.5.6 Combine harvester

2.5.7 Type of threshers

2.5.8 Rice thresher

2.5.9 Multi-crop thresher

2.5.10 Winnowing machine

2.5.11 Operation and maintenance of seeding, harvesting and threshing machinery

## **2.6 Mechanical Weeding and Chemical Application Equipment**

2.6.1 Manual weeders

2.6.2 Power weeders

2.6.3 Sprayers (its types, components, nozzle types, application)

- 2.6.4 Dusters
- 2.6.5 Operation and maintenance of Mechanical weeding and chemical application equipment
- 2.6.6 Testing of Mechanical weeding and chemical application equipment

## **2.7 Post Harvest Engineering**

### **2.8 Grain Drying**

- 2.8.1 Grain drying needs
- 2.8.2 Grain drying methods
- 2.8.3 Grain drying theory (thin layer and deep layer drying)
- 2.8.4 Mechanical dryers (batch and continuous type)

### **2.9 Rice Processing**

- 2.9.1 Traditional rice milling
- 2.9.2 Rice hulling, shelling and polishing
- 2.9.3 Rice parboiling
- 2.9.4 Beaten rice making
- 2.9.5 Equipment used in rice processing

### **2.10 Processing of Wheat, Maize, Legumes and Oilseed**

- 2.10.1 Milling
- 2.10.2 Hulling
- 2.10.3 Oil expelling
- 2.10.4 Hulling, grinding and oil expelling equipment

### **2.11 Processing and Preservation of Foods and Seeds**

- 2.11.1 Cold storage
- 2.11.2 Refrigeration in food processing industries
- 2.11.3 Seed processing equipment and storage
- 2.11.4 Dairy machinery (Pasteurization and sterilization, Can washers, Cream separators, Butter churns, Steam boilers)

### **2.12 Farm Structures**

### **2.13 Design of Structure and Building Material**

- 2.13.1 Material properties and choices of materials for farm structures
- 2.13.2 Design of RCC structure (beam, slab, foundation and column)
- 2.13.3 Design of steel and wooden structure (truss, beam and column)
- 2.13.4 Building materials (concrete, cement, lime, sand, bitumin, surkhi, mud, brick, stone, timber, Mild steel, GI sheet)

### **2.14 Planning of Farmstead and Farm Buildings**

- 2.14.1 Planning of farmstead
- 2.14.2 Farm residence
- 2.14.3 Water supply and sanitation



- 2.14.4 Farm road
- 2.14.5 Farm Fencing
- 2.14.6 Development and management of plant production system in controlled environment

## **2.15 Animal Shelters**

- 2.15.1 Dairy barn (housing requirements, stanchion barn, loose housing barn, barn equipment and accessories, milking barn, pen barn )
- 2.15.2 Poultry housing ( housing requirement, type of poultry house, brooder house, poultry equipment and accessories)
- 2.15.3 Sheep and goat housing (types, housing requirements, construction material, layout, equipment and accessories in goat and sheep housing)
- 2.15.4 Swine housing (types, housing requirements, construction materials, layout, equipment and accessories in swine housing)

## **2.16 Storage Structures**

- 2.16.1 Fodder storage structure
- 2.16.2 Feed storage structure
- 2.16.3 Food grain storage structure (Indigenous storage structure, Bag storage structure, grain bins, modern godowns)
- 2.16.4 Farm machinery storage structure and farm workshop

## **2.17 Electricity on the Farm**

- 2.17.1 Electric circuit
- 2.17.2 Distribution in farmstead
- 2.17.3 House wiring and its components
- 2.17.4 AC motor (single phase and poly phase)
- 2.17.5 AC motor starters
- 2.17.6 Selection of electric motors
- 2.17.7 Care and maintenance of electric equipment

## **3. Statistics**

- 3.1 Frequency, mean, median, mode, standard deviation, standard error, normal distribution, sampling methods, methods of hypothesis testing
- 3.2 Design of field experiments
- 3.3 Analysis of variance
- 3.4 Regression and correlation (simple linear regression and correlation)

## **4. Other**

- 4.1 Establishment of Nepal Agricultural Research Council and its organizational structure, role and function
- 4.2 Agricultural Development Strategy ( ADS) and policies of GoN
- 4.3 Irrigation Policy
- 4.4 Agriculture and irrigation in recent five year plan
- 4.5 Status of agricultural mechanization and agricultural mechanization policy
- 4.6 Irrigation situation In Nepal
- 4.7 Agricultural engineering related Institutions in Nepal

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**Paper: II**

**Technical Subject**  
**Sub-Group: Biostatistics/Biometrics**

- 1. Introduction**
  - 1.1 Basic concepts of statistics
  - 1.2 Statistics and biometrics
  - 1.3 Role of biometrics in agricultural research
  - 1.4 Measurement scales
  - 1.5 Variable/ observation and attribute
  - 1.6 Population and sample
- 2. Classification and Summarization of Data**
  - 2.1 Data collection
  - 2.2 Frequency distribution
  - 2.3 Diagram and graphs
- 3. Descriptive Statistical Measures**
  - 3.1 Measures of central tendency
  - 3.2 Measures of dispersion
  - 3.3 Measures of skewness and kurtosis
- 4. Probability and Distribution**
  - 4.1 Elementary probability and probability theory
  - 4.2 Normal distribution
  - 4.3 Binomial distribution
- 5. Sampling and Sampling Distribution**
  - 5.1 Concept of sampling, sampling error and non sampling error
  - 5.2 Simple random sampling, cluster, stratified and systematic sampling
  - 5.3 Sampling distribution of mean and proportion
  - 5.4 Standard error and concept of central limit theorem
- 6. Estimation and Testing of Hypothesis**
  - 6.1 Point estimation and their properties
  - 6.2 Confidence interval estimation and its interpretation in different scenario
  - 6.3 Hypothesis testing
  - 6.4 Null and alternative hypothesis
  - 6.5 Type I and type II error in testing of hypothesis
  - 6.6 Critical region, level of significance, power of the test
  - 6.7 One and two tailed tests
  - 6.8 Degrees of freedom
  - 6.9 Testing of hypothesis in different scenario



6.10 Critical value approach and p-value approach for decision making in testing of hypothesis

**7. Parametric Tests**

- 7.1 Z-test
- 7.2 Independent t-test
- 7.3 Paired t-test
- 7.4 F test for test of significance of variance and means
- 7.5 Applications of different parametric tests in agriculture data

**8. Non-parametric Tests**

- 8.1 Chi-square test,
- 8.2 Mann Whitney U-test
- 8.3 Wilcoxon's Signrank test
- 8.4 Kruskwallis test
- 8.5 Applications of different nonparametric tests in agriculture data

**9. Correlation**

- 9.1 Simple linear correlation
- 9.2 Rank correlation
- 9.3 Test of significance of correlation coefficient

**10. Regression**

- 10.1 Simple linear regression
- 10.2 Multiple linear regression
- 10.3 Test of hypothesis for regression coefficient and overall fit of the model
- 10.4 Assumptions of linear regression and applications
- 10.5 Use and misuse of correlation and regression analysis

**11. Experimental Design**

- 11.1 Basic concepts of statistical models and use of samples
- 11.2 Concepts of experimental design, factorial experiments
- 11.3 Principles and techniques of planning, establishing and executing field and greenhouse experiments
- 11.4 Completely randomized design
- 11.5 Randomized complete block design
- 11.6 Latin square design
- 11.7 Lattice design
- 11.8 Factorial experiments
- 11.9 Split-plot design
- 11.10 Experiment in farmers' fields
- 11.11 Assumptions and applications

**12. Special Application of Statistics**

- 12.1 Statistics in genetics and plant breeding
- 12.2 Statistics in livestock and fishery
- 12.3 Statistics in social science



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13. Understanding of biometrical software

14. Concept of research design, research methods and research methodology

15. Field Plot Technique

15.1 Size, shape and orientation of plots

15.2 Border and competition effects

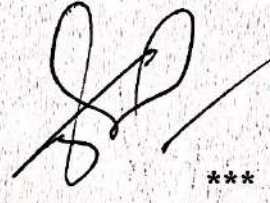
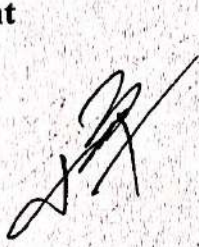
15.3 Soil heterogeneity

15.4 Estimation of size of experiments for specified accuracy

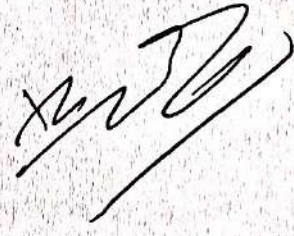
15.5 Sub-sampling plots and yields for laboratory analysis

16. Interpretation of statistical results and report writing

17. Statistical system of Nepal and databases focusing on agriculture research and development



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प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), वायोस्ट्याटिस्टिक्स उपसमूहको खुल्ला तथा  
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**Paper-II**

**Technical Subject**

**Sub-Group: Biostatistics (Biometrics)**

**1. Introduction**

- 1.1 Statistics and biometrics
- 1.2 Role of biometrics in agricultural research
- 1.3 Basic concepts of statistics
- 1.4 Measurement scales
- 1.5 Variable/ observation and attribute
- 1.6 Population and sample

**2. Classification and Summarization of Data**

- 2.1 Data collection
- 2.2 Frequency distribution
- 2.3 Diagram and graphs

**3. Measures of Central Tendency and Dispersion**

- 3.1 Measures of central tendency
- 3.2 Measures of dispersion

**4. Probability and Distribution**

- 4.1 Elementary probability and probability theory
- 4.2 Normal distribution
- 4.3 Binomial distribution

**5. Sampling**

- 5.1 Sampling design
- 5.2 Sampling fundamental

**6. Testing of Hypothesis**

- 6.1 Hypothesis
- 6.2 Hypothesis testing
- 6.3 Critical region and level of significance
- 6.4 One and two tailed tests
- 6.5 Degree of freedom
- 6.6 Test of hypothesis
- 6.7 Important parametric test
- 6.8 Limitation

## **7. Non-parametric Test**

- 7.1 Chi-square test
- 7.2 Sign test
- 7.3 Wilcoxon's signed rank test
- 7.4 Rank correlation

## **8. Correlation**

- 8.1 Simple linear correlation
- 8.2 Test of hypothesis

## **9. Regression**

- 9.1 Simple linear regression
- 9.2 Multiple linear regressions
- 9.3 Test of hypothesis
- 9.4 Assumption and problem data
- 9.5 Use and misuse of correlation and regression analyses

## **10. Experimental Design**

- 10.1 Basic concepts of statistical models and use of samples
- 10.2 Concepts of experimental design, factorial experiments
- 10.3 Principles and techniques of planning, establishing and executing field and greenhouse experiments
- 10.4 Completely randomized design
- 10.5 Randomized complete block design
- 10.6 Latin square design
- 10.7 Lattice design
- 10.8 Factorial experiments
- 10.9 Split-plot design
- 10.10 Experiment in farmers' fields
- 10.11 Assumption and problem data

## **11. Means Comparisons**

- 11.1 Pair comparison
- 11.2 Group comparison

## **12. Special Application of Statistics**

- 12.1 Statistics in genetics and plant breeding
- 12.2 Statistics in livestock and fishery
- 12.3 Statistics in social science

## **13. Biometrical Software**

## **14. Research Materials, Methods and Methodology**

## **15. Field Plot Technique**

- 15.1 Size, shape and orientation of plots
- 15.2 Border and competition effects
- 15.3 Soil heterogeneity
- 15.4 Estimation of size of experiments for specified accuracy
- 15.5 Sub-sampling plots and yields for laboratory analysis

## **16. Interpretation and Report Writing**

## **17. Statistical System in Nepal and Databases**

## **18. Others**

- 18.1 Agriculture Development Strategy
- 18.2 NARC Vision
- 18.3 Agriculture related policy and strategy (national and international)
- 18.4 Nepal Agricultural Research Council
- 18.5 Agriculture research and development: History, achievements, constraints and scope
- 18.6 Agricultural statistics



प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), फूड टेक्नोलोजी उपसमूहको खुल्ला तथा आन्तरिक  
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**Paper-II**

**Technical Subject**  
**Sub-Group: Food Technology**

**1. Post Harvest Technology**

- 1.1 Post harvest Technology of Fruits, Vegetables, Cereal, Legumes, Oilseeds, Tea and Coffee, Spices and Meat and meat products (fish and poultry) Milk and dairy products
- 1.2 Post harvest handling and general methods of food preservation
- 1.3 Uses of various packaging material and containers in fresh and processed foods.
- 1.4 Thermal processing of foods
- 1.5 Application of irradiation in food preservation
- 1.6 Infestation control and use of pesticides on foods
- 1.7 Preservation of food with food additives
- 1.8 Short and long term storage for perishable food commodities
- 1.9 Cellar storage, Modified atmosphere storage and control atmosphere storage
- 1.10 Post harvest loss of crops, fruits, vegetables and methods of its minimization

**2. Food Engineering**

- 2.1 Concept of Unit operation, (a) Material Balance (b) Heat balance and evaluation of heat requirement
- 2.2 Fluid flow
- 2.3 Heat Transfer: (a) Conduction, Convection and Radiation, (b) Heat exchangers, (c) Law of thermodynamics
- 2.4 Principle of various methods of drying and dehydration and uses in food industries
- 2.5 Size separation, size reduction and sieve analysis, filtration, sedimentation
- 2.6 Concentration and evaporation
- 2.7 Distillation (a) Vapor-liquid relationship (b) Rectification (c) Fractional distillation
- 2.8 Freezing and refrigeration, steam generation and its utilization, boiler operation and maintenance

**3. Food Chemistry**

- 3.1 Principles and development of food chemistry
- 3.2 Proximate composition of foods and their determination
- 3.3 Carbohydrates: monosaccharides, disaccharides, polysaccharides and their general definition, properties, occurrence and structures
- 3.4 Protein: definition, occurrence, physical and chemical properties, structure and amino acid, classification of protein and their properties, food proteins
- 3.5 Lipids: definition, occurrence and composition, fatty acid, hydrogenation, rancidity shortening and margarine
- 3.6 Moisture in foods, natural pigments in foods, vitamins in foods, flavoring compounds and food additives



- 3.7 Browning in foods: enzymatic and non enzymatic browning, Millard reaction and methods of preventing browning and caramelization
  - 3.8 Concept and principles of new food product development
- 4. Food Microbiology**
- 4.1 Morphology and cytology of bacteria, yeasts, molds
  - 4.2 General principle of serology and immunology
  - 4.3 Bacterial nutrition and metabolism
  - 4.4 Growth, reproduction, transformation, mutation and spore formation of microorganism
  - 4.5 Microbiology of environment; air water and soil
  - 4.6 Microbiology of meat and meat products (fish, poultry) milk and milk products, fruits and vegetables products, poultry and poultry products, cereals and cereals products, spices
  - 4.7 Food-borne infection, intoxication and mycotoxins
  - 4.8 Industrial uses of microorganism
  - 4.9 General techniques of selection and preservation of microorganisms
  - 4.10 Food fermentation, indigeneous fermented foods of Nepal
  - 4.11 Microbiology assay of nutrient.
  - 4.12 Single cell protein
  - 4.13 Concept of prebiotics and probiotics
- 5. Biochemistry and Human Nutrition**
- 5.1 Introductory of cell biochemistry.
  - 5.2 Enzymes: general properties, classification, kinetics, coenzymes, and enzyme in food industry
  - 5.3 Metaboism of carbohydrate, lipid and protein metabolism
  - 5.4 Losses of nutrients in foods processing and preservation
  - 5.5 Classification and function of nutrients, nutritional classification of food, energy value of food, recommended dietary allowances, digestion absorption and metabolism of food, nutritional quality of protein, food composition tables and its uses.
  - 5.6 Antinutritional factors in food.
  - 5.7 Balance diet and dietary guidelines and food pyramid. Relation of nutrition with life style and food habits
  - 5.8 Nutrition of pregnant, lactating mother, infant, preschooler
  - 5.9 Supplementary foods
  - 5.10 Enrichment and fortification of food
  - 5.11 Present status of malnutrition in Nepal
  - 5.12 Malnutrition and nutrient deficiency disorders and food based approach of nutrition
- 6. Quality Control**
- 6.1 Introduction to the concept of food safety, quality control and quality assurance
  - 6.2 Quality attributes of foods
  - 6.3 Sensory evaluation of foods & beverages
  - 6.4 Preventive approach of food safety and quality control, concept of total quality management

- 6.5 Principles of Hazard Analysis and Critical Control Points (HACCP) and its application in food industries
  - 6.6 Food chain concept of food safety and quality
  - 6.7 Pesticides and veterinary drug residues in food
  - 6.8 Role of food standards in maintaining the quality and safety of food
  - 6.9 Methods of food analysis: principles of gas liquid chromatography (GLC), High Performace Liquid Chromatography (HPLC), Atomic Absorption Spectrometry (AAS)
  - 6.10 Analysis of trace elements, additives (SO<sub>2</sub>, benzoate, colouring agents)
  - 6.11 Current Food Act and food regulations in Nepal
  - 6.12 Current Feed Act and regulations in Nepal
  - 6.13 Food sampling & inspection techniques and tools
  - 6.14 Food adulteration, food poisoning out break trends in Nepal
  - 6.15 Concept of laboratory accreditation and Good Laboratory Practices (GLP)
  - 6.16 Food plant sanitation, Hygienic design and good hygienic practices
  - 6.17 Control of contaminants and microorganisms in food industries
- 7. Statistics**
- 7.1 Preliminary ideas of statistics, mean, mode, median
  - 7.2 Frequency distributions
  - 7.3 Basic concept of normal distribution and probability
  - 7.4 Basic concept of regression and correlation
  - 7.5 Test of significance: Chi-square test, T and Z test and F-value
  - 7.6 Sampling techniques and methods of data collection and data analysis
- 8. Others**
- 8.1 Role of food technology in agricultural development and research
  - 8.2 Food marketing: issues of food safety and quality
  - 8.3 Role of food technology in assuring food safety and security in Nepal
  - 8.4 Scope of reseach and development in food technology and nutrition

प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), एनिमल न्यूट्रिशन एण्ड फिडिङ उपसमूहको  
खुल्ला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**

**Sub-Group: Animal Nutrition and Feeding**

**1. General Chemistry**

- 1.1 Atoms, Molecules, and Ions
- 1.2 Status of Matter and Solutions
- 1.3 Chemical reactions and equilibrium,
- 1.4 Calculations with chemical formulas and equations
- 1.5 Organic Chemistry
  - 1.5.1 Hydrocarbons
  - 1.5.2 Derivatives of hydrocarbons
- 1.6 Bio-Chemistry
  - 1.6.1 Introduction to Biological systems
  - 1.6.2 Biological molecules

**2. Genetics and Livestock Breeding**

- 2.1 Principles of genetic
- 2.2 Heritability
- 2.3 Repetability
- 2.4 Inbreeding

**3. Reproduction and Physiology**

- 3.1 Fertility and infertility
- 3.2 Multiple ovulation
- 3.3 Introductory knowledge of physiology

**4. Dairy Science**

- 10.1 Chemistry of milk
- 10.2 Microbiology of milk
- 10.3 Preservation and transportation of raw milk
- 10.4 Dairy product diversification

**5. Major Diseases of Farm Animals and Birds**

- 5.1 Bacterial
- 5.2 Viral
- 5.3 Parasitic
- 5.4 Metabolic and nutritional diseases

**6. Digestive System of Avian and Animal**

- 6.1 Anatomy and function of gastrointestinal tract.
- 6.2 Fecal and urinary extraction
- 6.3 Role of digestive enzyme

- 6.4 Rumen metabolism
- 6.5 Rumen fermentation
- 6.6 Blood and nutrition

## **7. Nutrition of Farm Animals and Birds**

- 18.1 Nutrients
- 18.2 Proximate analysis and detergent analysis of feeds
- 18.3 Classification of feeds
- 18.4 Basal Feeds
- 18.5 Protein supplements
- 18.6 Vitamin and mineral supplements and additives
- 18.7 Forages and roughages
- 18.8 Feeding standards
- 18.9 Energy values of feeds
- 18.10 Protein values of feeds

## **8. Principle of Animal Nutrition**

- 8.1 Importance of different feed nutrients.
  - 8.1.1 Crude protein, carbohydrate, fat, lipids and water.
  - 8.1.2 Minerals and vitamins
- 8.2 Sources of feed nutrients
- 8.3 Importance of feed supplements and additive
- 8.4 Use of cereals and agro industrial by products in the ration
- 8.5 Digestive systems of ruminants and non ruminants
- 8.6 Role of enzymes and hormones in the digestion
- 8.7 Importance of the feeding standard
- 8.8 Existing conventional and non-conventional feeding system in Nepal
  - 9.8.1 Cattle, buffalo, sheep and goat
  - 9.8.2 Pig, poultry and rabbits
- 8.9 Nutrients requirement for different ruminants and non ruminants' animals.
- 8.10 Ration formulation for ruminants and non ruminants
- 8.11 Chemical analysis and its implication in the ration formulation
- 8.12 Importance of laboratory facilities

## **9. Nutrition of Farm Animals and Birds**

- 9.1 Nutrients
- 9.2 Proximate analysis and detergent analysis of feeds
- 9.3 Classification of feeds
- 9.4 Basal Feeds
- 9.5 Protein supplements
- 9.6 Vitamin and mineral supplements and additives
- 9.7 Forages and roughages
- 9.8 Feeding standards
- 9.9 Energy values of feeds
- 9.10 Protein values of feeds

**10. Pasture, Fodder and Fodder Tree**

- 10.1 Introductory plant taxonomy
  - 10.1.1 Classification of grasses
  - 10.1.2 Classification of fodder tree
- 10.2 Plant physiology
  - 10.2.1 Plant metabolism
  - 10.2.2 Growth and development pattern
- 10.3 Distribution and classification of grass land
- 10.4 Grassland improvement techniques
- 10.5 Agronomic and other management practices
  - 10.5.1 Pasture species
  - 10.5.2 Fodder crops
  - 10.5.3 Fodder trees
- 10.6 Grazing management system
- 10.7 Conservation of forages
- 10.8 Herbage quality
- 10.9 Nursery establishment and management

**11. Statistics**

- 11.1 Organization and description of data
- 11.2 Probability
- 11.3 RCBD
- 11.4 CRD
- 11.5 Experimental Design

**12. Others**

- 11.1 Livestock and Poultry population and their distribution in Nepal
- 11.2 Production and productivity of livestock and Poultry in Nepal
- 11.3 Pasture, Forage and Agro-forestry status in Nepal
- 11.4 Organization structure, scope and opportunity of NARC

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नेपाल सरकार  
नेपाल कृषि अनुसन्धान परिषद्  
पदपूर्ति समिति

प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), लाइभस्टक प्रडक्ट प्रोडक्शन एण्ड म्यानेजमेण्ट उपसमूहको  
खुल्ला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**

**Sub-Group: Livestock Product Production and Management**

**1. Production and Management**

- 1.1 Animal (Cattle/Buffalo/Sheep/ Goats and Swine) Production and Management System in Nepal
- 1.2 Characteristics of Native and exotic livestock breed of Nepal
  - 1.2.1 Cattle: Native - Lulu, Achhami, Siri, Pahadi, Khaila and Terai  
Exotic - Jersey, Holstein Friesian, Brown Swiss, Hariyana and Ayreshire
  - 1.2.2 Buffalo: Native – Parkote, Lime and Gaddi  
Exotic – Murraha and Nili Ravi
  - 1.2.3 Sheep: Native- Bhyanglung, Baruwal, Kage and Lampuchhare  
Exotic - Polwarth, Merino, Romney Marsh and Rambouillet
  - 1.2.4 Goat: Native - Chyangra, Sinhal, Khari and Terai Goat  
Exotic - Jamunapari, Barberi, Black Bengal, Boer, Sannen and Azmeri
  - 1.2.5 Swine Native-Hurrah, Chwanche, Bampudke, Nepali improved- Pakhribas black  
Exotic - Landrace, Berkshire, Yorkshire, Duroc, Hampshire
  - 1.2.6 Poultry Exotic - White Leghorn, New Hampshire, Austrolop, Giriraja
  - 1.2.7 Native Poultry – Sakini, Ghantikhuile, Punkhulte
  - 1.2.8 Rabbit Exotic - Angora, Chinchilla, Californian Hyline, Newzeland white
- 1.3 Advanced Livestock Feeding Management
- 1.4 Site Selection and Improved Housing Management
- 1.5 Reproduction – Seasonality, estrous cycle and mating behavior of farm animals.
- 1.6 Advanced Animal Breeding Management, Methods of Breeding
- 1.7 Feeding Management for Cows, Buffaloes, Ewes and Does for breeding
- 1.8 Selection of animals / avian for breed improvement
- 1.9 Planning of small holder dairy farm, commercial scale of sheep farm (wool and meat, goat farm for meat)
- 1.10 Commercial farming Poultry and Swine
- 1.11 Hatchery Management (Poultry, Quail, Turkey) and chick production
- 1.12 Age Determination of ruminant farm animals by dentition
- 1.13 Principle of Dehorning, Castration and Debeaking its methods
- 1.14 Dipping and Shearing process for sheep
- 1.15 Care and Management of sick animals, Isolation shed management, Segregation and Quarantine Management

**2. Animal Nutrition**

- 2.1 Animal Feed Classification ; Importance of feed nutrients – Protein, Carbohydrate
- 2.2 Fat, Lipids, Water, Minerals and Vitamins
- 2.3 Digestive Systems of Ruminant and Non- Ruminants

- 2.4 Role of Enzymes and Hormones in Digestive Systems
- 2.5 Estimations of feed requirement for different stages of farm animals and avian.
- 2.6 Ration Formulations for Livestock / avian species.

### **3. Pasture and Fodder**

- 3.1 Plant Taxonomy Classification of fodder grass, leguminous crops and fodder tree.
- 3.2 Plant Physiology – Plant Metabolism, Growth and development pattern.
- 3.3 Management practices for pasture production, forage production, fodder trees
- 3.4 Principle of Silage and Hay Making

### **4. Dairy in Nepal**

- 4.1 History and present status
- 4.2 Definition of Milk and theories of Milk Secretion.
- 4.3 Composition of milk of different farm animals (Cows, Chauri, Buffalo and Goat)
- 4.4 Pasteurization and processing of Milk
- 4.5 Preparation of Milk Products: Cheese, Butter, Paneer, Yoghurt, Khuwa, Ice cream, Ghee and Chhurpi
- 4.6 Testing of quality and adulteration of milk
- 4.7 Dairy research

### **5. Meat Production**

- 5.1 Meat production from goat, buffalo, pig, sheep, rabbit and poultry in Nepal.
- 5.2 Methods of slaughtering of animals and birds
- 5.3 Contribution of meat in GDP
- 5.4 Scope of increasing meat production from goat, buffalo and pig in Nepal
- 5.5 Estimation of dressing percentage in different livestock species

### **6. Wool**

- 6.1 Definition of wool, Fur and Mohair
- 6.2 Classification of wool
- 6.3 Types of wool produced in Nepal

### **7. Animal Health**

- 7.1 Important Ecto and Endoparasitic diseases and its treatment of farm animals and avians
- 7.2 Important contagious diseases

### **8. Statistics**

- 8.1 Knowledge about statistical data analysis
- 8.2 Correlation and Regression
- 8.3 Analysis of Variance
- 8.4 Experimental design on farm animals and avian with data analysis packages

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## **Paper-II**

### **Technical Subject**

#### **Sub-Group: Animal Breeding and Genetics**

#### **1. Principles of Genetics and Population Genetics**

- 1.1 Definition, importance and history of genetics
- 1.2 Study of animal cell and Cell division
- 1.3 Chromosomes, types of chromosomes and number of chromosomes in different animals
- 1.4 Mendelian principles
- 1.5 Dihybrid and polyhybridisation
- 1.6 Genetic constitution of population-frequencies of genes and genotypes, Hardy-Weinberg equilibrium
- 1.7 Segregation and recombination of gene
- 1.8 Gene interaction, epistasis and multiple alleles
- 1.9 Linkage and crossing over
- 1.10 Sex controlled inheritance and sex determination
- 1.11 Mutation and chromosomal aberrations
- 1.12 Cytoplasmic inheritance
- 1.13 Quantitative inheritance
- 1.14 Heredity and environment
- 1.15 Selection, migration, mutation and population size
- 1.16 Coefficient of inbreeding and genetic relationship
- 1.17 Values and means
- 1.18 Variances-genetic and environmental
- 1.19 Resemblance-genetic and phenotypic

#### **2. Principles of Animal Breeding**

- 2.1 Definition, importance, achievements and history of Animal Breeding
- 2.2 Application of Genetic Principles in Animal Breeding
- 2.3 Gene and genotypic frequencies
- 2.4 Qualitative and quantitative inheritance
- 2.5 Measure of genetic and phenotypic relationship
- 2.6 Calculation of Breeding values
- 2.7 Heredity and environment
- 2.8 Principles of mating systems
- 2.9 Principles of selection; Basis and methods of selection
- 2.10 Hybrid vigour/heterosis and estimation of heterosis
- 2.11 Genetic gain/Response to selection
- 2.12 Heritability and Repeatability
- 2.13 Correlations-Genetic, phenotypic and environmental
- 2.14 Dissemination methods
- 2.15 Development of Breeding plan for domestic livestock and poultry



**3. Reproduction, Physiology and Biotechnology**

- 3.1 Definition, scope and importance of Biotechnology
- 3.2 Application of Biotechnology tools in Animal Improvement
- 3.3 Artificial Insemination techniques
- 3.4 Collection, processing, evaluation and storage of fresh and frozen semen
- 3.5 Pregnancy Diagnosis
- 3.6 Embryo collection, embryo transfer technology in livestock development
- 3.7 Reproductive disorders and their corrective measures
- 3.8 Reproductive systems of domestic animals
- 3.9 Reproduction parameters in domestic animals
- 3.10 Hormones of reproduction and their functions; Estrous cycle, ovulation, fertilization and parturition
- 3.11 Induction and Heat synchronization

**4. Conservation, Utilization and Promotion of Indigenous Animal Genetic Resources**

- 4.1 Identification of indigenous breeds of domestic animals
- 4.2 Characterization of indigenous breeds of domestic animals
- 4.3 Status of indigenous breeds in relation to conservation
- 4.4 Positive attributes of indigenous breeds
- 4.5 Available introduced breeds

**5. Statistics**

- 5.1 Definition and importance of Statistics
- 5.2 Experimental design
- 5.3 Mean, Median and Mode
- 5.4 Measures of dispersion- Variance, Standard deviation, Standard errors etc
- 5.5 Analysis of Variance (ANOVA)
- 5.6 Regression and Correlation analysis

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प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), पाश्चर फोरेज एण्ड एग्रो फरेष्ट्री उपसमूहको  
खुल्ला तथा आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**

**Sub-Group: Pasture/Forage and Agro-Forestry**

**1. Forage Physiology**

- 1.1 Photosynthesis and respiration
- 1.2 Seed germination, dormancy and other physiological processes associated with seed production

**2. Forage Breeding**

- 2.1 Principles of breeding
- 2.2 Breeding and improvement objectives
- 2.3 Breeding methods

**3. Forage Agronomy**

- 3.1 Plant introduction, evaluation and utilization
- 3.2 Fertilization and liming
- 3.3 Cutting management
- 3.4 Irrigation management
- 3.5 Cropping systems, crop rotation, inter-cropping, mixed cropping, multiple cropping and mixed farming systems
- 3.6 Nursery establishment and management

**4. Production Technology**

- 4.1 Production technology of forage crops
- 4.2 Production technology of temperate fodder and forage species
- 4.3 Production technology of tree fodder trees

**5. Grazing and Range Management**

- 5.1 Grazing practices
- 5.2 Stocking rate and grazing pressure
- 5.3 Livestock units, Grassland productivity and carrying capacity

**6. Herbage quality and Nutritive value**

- 6.1 Nutritive value, digestibility and forage intake
- 6.2 Feeding value of grass, legume and its products

**7. Agro-forestry**

- 7.1 Scope and advantage
- 7.2 Classification of agro-forestry systems
- 7.3 Management of trees in agro-forestry systems

7.4 Forage, fodder and tree species for multi tier production systems

**8. Forage Conservation**

8.1 Principles of conservation

8.2 Silage making

8.3 Hay making

**9. Forage Toxicology**

9.1 Antiquality constraints and disorders

**10. Forage diseases and their control**

10.1 Diseases of pasture/forage and fodder trees, seed borne, soil borne and air borne diseases

10.2 Biological control and cultural control measures of pasture/forage and fodder tree pathogens

**11. Forage insects management and their control**

11.1 Principles of insect- pest control

11.2 Physical and mechanical control, cultural control, biological control, chemical control and host plant resistance

**12. Statistics**

12.1 Experimental designs and data analysis (parametric and non- parametric)

12.2 Central tendency, dispersion, ANOVA, regression and correlation

**13. Others**

13.1 Livestock population and their distribution in Nepal

13.2 Production and productivity of livestock in Nepal

13.3 Ruminant's digestive, productive and reproductive systems

13.4 Classification of feeds

13.5 Proximate analysis of feeds

13.6 Types of grassland and its distribution

13.7 Feed balance situation in Nepal

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पदपूर्ति समिति  
प्राविधिक अधिकृत, टि-६ (Technical Officer, T-6), फिसरीज उपसमूहको खुल्ला तथा आन्तरिक  
प्रतियोगितात्मक लिखित परीक्षाको लागि पाठ्यक्रम

**Paper-II**

**Technical Subject**  
**Sub-Group: Fishery**

**1. Taxonomy of Finfish and Shellfish**

- 1.1 Nomenclature; Classification and interrelationships; Criteria for generic and specific identification; Morphological, morphometric and meristic characteristics of taxonomic significance; Major taxa of inland fishes and commercially important crustaceans and mollusks up to family level

**2. Anatomy and Biology of Fish and Shellfish**

- 4.1 External and internal features of fish: Integumentary system: Skin, scale and fin, skeletal system: Axial and appendicular skeleton; digestive system: alimentary canal and associated glands, Respiratory system: Gill, and accessory respiratory organs; Excretory system: kidney, Excretion and osmo-regulation; Reproductive system: Male and female reproductive organs, Seasonal cycles, gametogenesis, Endocrine glands in fishes
- 4.2 Digestive system and associated glands; Reproductive system: Male and female reproductive organs, and life cycle of prawn and snail; Pearls formation of mollusks

**3. Aquaculture Production System in Nepal**

- 3.1 Biological characteristics of cultured fishes and Shellfish:- Common carp, rohu, naini, bhakur, silver carp, bighead carp, grass carp, silver barb, tilapia, pangas, rainbow trout and Prawn
- 3.2 Principles and practices of fish culture systems in Nepal
- A: Aquaculture System
- 3.2.1 Monoculture
- 3.2.2 Polyculture
- 3.2.3 Monosex culture
- B: Aquaculture Techniques
- 3.2.4 Extensive
- 3.2.5 Semi-intensive
- 3.2.6 Intensive
- 3.2.7 Super-Intensive
- C: Aquaculture Practices
- 3.2.8 Pond fish culture
- 3.2.9 Raceway culture
- 3.2.10 Cage fish culture
- 3.2.11 Enclosure fish culture
- 3.2.12 Integrated fish Farming
- 3.2.12.1 Poultry birds (chicken and ducks)-fish system
- 3.2.12.2 Horticulture (vegetables and fruits)-fish system

- 3.2.12.3 Grass-fish system
- 3.2.12.4 Livestock (Piggery)-fish system
- 3.2.12.5 Rice-fish culture
- 3.2.12.6 Fish-fish culture (Carp-SIS)
- 3.2.12.7 Aquaponics

#### **4. Pond Construction and Management**

- 4.1 Site survey, pond soil characteristics
- 4.2 Pond design and construction
- 4.3 Types of pond, nursing and rearing pond, production pond, and brood fishpond
- 4.4 Pond liming
- 4.5 Pond fertilization

#### **5. Fish Breeding of Cultivable Species**

- 5.1 Brood fish management
- 5.2 Methods of brood fish selection for breeding
- 5.3 Breeding technique-Natural breeding, Semi artificial breeding and artificial/induced breeding
- 5.4 Hormones use techniques and doses
- 5.5 Selective breeding of economically important fishes of Nepal

#### **6. Hatchery Management**

- 6.1 Importance of quality seeds
- 6.2 Hatcheries operation-spawning, fertilization, incubation, hatching and larvae nursing,
- 6.3 Nursery Technique-Nursery ponds and its preparation, stocking, and fry rearing
- 6.4 Fry transportation methods

#### **7. Fish Feed and Nutrition**

- 7.1 Physiology of digestion and excretion of fish
- 7.2 Nutritional requirements of cultivable fish and shellfish
- 7.3 Feed formulation and evaluation
- 7.4 Feed additives
- 7.5 Non- conventional feed ingredients
- 7.6 Anti-nutritional factors
- 7.7 Nutritional deficiency sign and symptoms

#### **8. Live Food Production**

- 9.1 Nutritional value of live food
- 9.2 Candidate species of phytoplankton and zoo-plankton as live food organisms of freshwater species
- 9.3 Biology and culture requirements of important live food organisms

#### **9. Water Quality Management**

- 9.1 Physical and chemical water quality parameters
- 9.2 Aquaculture intensification, pond bottom management and water quality inter-relationships
- 9.3 Sampling methods and waterquality analysis

## **10. Aquatic Animal Health Management**

- 10.1 Relationships of the Host, Pathogen, and Environment: Implications
- 10.2 Modes of disease transmission
- 10.3 Factors affecting fish health
- 10.4 General symptom of diseased fish
- 10.5 Bacterial disease of fish (bacterial gill disease, dropsy, tail and fin rot, and columnaris), symptoms and treatment measures
- 10.6 Fungal disease of fish (Saprolegniosis and EUS), symptoms and treatment measures
- 10.7 Protozoan parasitic causes fish disease, symptoms and treatment measures
- 10.8 Disease caused by crustaceans (Lernaea and Argulus), symptoms and treatment measures
- 10.9 Disease caused cestodes (tapeworm), symptoms and treatment measures
- 10.10 Non infectious diseases (Gas bubble disease, and Hepatoma)
- 10.11 Fish predators and their control measures
- 10.12 Common drugs, chemicals and their application in aquaculture
- 10.13 Good Aquaculture Practices

## **11. Fish Kills**

- 11.1 Overabundant Aquatic Vegetation/ Planktonic algae, Asphyxia, and preventive measure
- 11.2 Issues of improper Aquatic herbicides use, poisoning
- 11.3 Pond turnover and prevention

## **12. Ornamental Fish Production and Management**

- 12.1 Aquarium construction and fabrication of ornamental fish rearing facilities.
- 12.2 Important native and exotic ornamental fish species.
- 12.3 Ornamental aquatic plants.
- 12.4 Breeding of aquarium fish
- 12.5 Aquarium fish disease
- 12.6 Nutritional requirement of aquarium fish.

## **13. Post-Harvest Technology**

- 13.1 Fish processing and preservation methods
- 13.2 Fish packing methods and value addition
- 13.3 Fisheries byproducts

## **14. Biostatistics**

- 14.1 Measures of central tendency- Mean, Median, Mode
- 14.2 Measures of dispersion- quartile deviation, range, variance, mean and standard variation.
- 14.3 Probability: normal distribution, standard sampling error and test of hypothesis, estimate of error
- 14.4 T-test, F-Test and Chi-square test.
- 14.5 Regression and correlation: simple linear regression and correction

## **15. Main objectives of NARC, Role of Fisheries Research Division, Centers and units under NARC**

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**Paper-II**

**Technical Subject**  
**Sub-Group: Veterinary**

**1. Veterinary Physiology and Biochemistry and Biotechnology**

- 1.1 Cell Physiology, blood and special fluid system of body
- 1.2 Physiology of digestive, respiratory and cardiovascular system, neurophysiology and myophysiology
- 1.3 Physical biochemistry-concentration of solution, diffusion, osmotic pressure, pH and buffer system
- 1.4 Diagnostic Biochemistry-Blood sugar, keton bodies, blood urea, nitrogen uric acid, and enzymes
- 1.5 Basic principles of biotechnology, DNA, RNA, PCR and monoclonal antibodies

**2. Veterinary Pathology**

- 2.1 General pathology-Degeneration, necrosis, circulatory disturbances, inflammation, repair, disturbances of growth and neoplasia
- 2.2 Systemic pathology-diseases of body system (urogenital, skeletal, muscular, cutaneous, endocrine and nutritional )
- 2.3 Special pathology-important disease of tropical animals ( Rinderpest , Foot and mouth disease, Anthrax, Rabies, Ephemeral fever, H.S, B.Q,TB, Johnes Disease, Brucellosis, Fascioliasis, Paramphistomiasis, Ascariasis, Hydatidosis, Taeniasis, Hookworm, canine distemper, Infectious canine hepatitis, Parvo virus enteritis, coccidiosis, metabolic diseases )
- 2.4 Poultry pathology-Important diseases of poultry in Nepal (Marek's Disease, New castle disease, Infectious laryngotacheitis, Avian influenza, Infectous Bronchitis, Mycoplasmosis, Coryza, Pullorum Disease, Fowl typhoid, Spirochaetosis, Avian encephalomyelitis, Inclusion body Hepatitis/Leechy heart disease, Egg Drop Syndrome, Coccidiosis, Endoparasites, Reoviral arthritis, Avian pox, Mycotoxicoses, Nutritional deficiency diseases, Infectious anaemia, Aspergillosis, Fowl cholera)

**3. Veterinary Parasitology**

- 3.1 Historical background of veterinary parasitology
- 3.2 Morphology and life cycle of helminth, arthropods and protozoans of veterinary importance prevalent in Nepal and their pathogenesis, clinical signs, diagnosis, control and treatment
- 3.3 Parasitic Zoonosis, Principles and methods of veterinary epidemiology in relations of parasitic infections, Host parasite relationship

**4. Veterinary Pharmacology and Toxicology**

- 4.1 Historical development of Pharmacology

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- 4.2 Systemic pharmacology (Pharmacology of drugs action on digestive, cardiovascular, respiratory, urinary and reproductive systems)
  - 4.3 Neuropharmacology (Anaesthetics, hypnotics, Analptics, antipyretics, histamine and antihistaminics)
  - 4.4 Toxicity caused by elements, chemicals, feed additives and preservatives
  - 4.5 Veterinary jurisprudence
- 5. Veterinary Microbiology (Bacteriology, Mycology and Virology)**
- 5.1 Developmental history of veterinary microbiology, Morphology, Genetics and classification of bacteria, fungi, Rickettsia and Mycoplasma of Veterinay importance
  - 5.2 Pathogenic bacteria and fungi in relation to morphology, isolation, growth, biochemical and antigenic characters and pathogenesis
  - 5.3 Sterilization, antiseptics and disinfectants
  - 5.4 Structure of animal virus; Classification of animals virus; General characteristics of various families of RNA and DNA virus
  - 5.5 Interference and Interferon
  - 5.6 Cultivation of virus; pox disease of cow, sheep, goat and fowl; African swine fever; Swine, Equine and Avian influenza. Pseudo-rabies, infectious bovine rhino -trachitis, Marek'sdesease, infectious laryngo-tracheitis, canine distemper, Ranikhet disease, Rinderpest, Blue tongue, Rabies, Ephemeral fever. Infectious Bronchitis, Transmissible gastroenteritis, Infectious canine hepatitis, egg drop syndrome, Papillomatosis, Swine fever, Mucosal disease, Foot and mouth disease, Duck virus hepatitis, Avian leucosis complex, oncogenic viral infection.; Bovine spongiform disease
- 6. Epidemiology**
- 6.1 Definition and application of epidemiology
  - 6.2 Ecological concepts of epidemiology
  - 6.3 Pattern of disease distribution in the community
- 7. Modern Diagnostic Techniques**
- 7.1 Specimen collection, preservation and transportation with reference to haematological, Microbiological and biochemical investigation
  - 7.2 Important Immuno diagnostics techniques (HA, HI, CFT, Plate agglutination test and ELISA )
  - 7.3 Antigen and vaccine
- 8. Veterinary Medicine and Public Health**
- 8.1 Clinical medicine - Method of Physical examination, general and special examination of skin, conjunctiva, body temperature and other systems of body.
  - 8.2 Haematology - different components of blood, Coagulation factors, anaemia, role of platelets, haemoglobin, haemophilia
  - 8.3 Definition, etiology, symptoms, diagnosis, treatment, control and prevention of diseases prevalent in domestic animals /poultry in Nepal.
  - 8.4 Zoonoses, Meat, milk and water born diseases
  - 8.5 Meat inspection, Quarantine, Biosecurity



**9. Theriogenology**

- 9.1 Pattern of reproduction in female farm animals (reproduction hormones, oestrus cycle, behaviour, ovulation, Super ovulation, fertilization and gestation, rectal examination, pregnancy diagnosis)
- 9.2 Andrology
- 9.3 Accidents of gestation
- 9.4 Parturition and post parturient complication in farm animals
- 9.5 Reproductive disorders in farms animals

**10. Statistics**

- 10.1 Experimental designs and data analysis (parametric and non- parametric)
- 10.2 Central tendency, dispersion, ANOVA, regression and correlation

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नेपाल सरकार  
नेपाल कृषि अनुसन्धान परिषद्  
पदपूर्ति समिति

कम्प्युटर अधिकृत, टि-६ पद/तहको खुला तथा आन्तरिक प्रतियोगितात्मक  
लिखित परीक्षाको पाठ्यक्रम एवं परीक्षा योजना

यस पाठ्यक्रम योजनालाई दुई चरणमा विभाजन गरिएको छ ।

प्रथम चरण: लिखित परीक्षा (Written Examination)  
द्वितीय चरण: प्रयोगात्मक (Practical Examination)  
अन्तरवार्ता (Interview)

पूर्णाङ्क: १५०  
पूर्णाङ्क: ५०  
पूर्णाङ्क: ३०

१. प्रथम चरण: लिखित परीक्षा (Written Examination)

पूर्णाङ्क: १००

Paper	Subject	Section	Full Marks	Pass Marks	No. of Question x Marks	Time
I		-	50	20	50 (Q) x 1 (M) = 50 (MCQs)	45 Minutes
II	कम्प्युटर सम्बन्धी	A	50	20	6 (Q) x 5 (M) = 30 (Short Answer) 2 (Q) x 10 (M) = 20 (Long Answer)	3.00 Hours
		B	50	20	6 (Q) x 5 (M) = 30 (Short Answer) 2 (Q) x 10 (M) = 20 (Long Answer)	

२. द्वितीय चरण: प्रयोगात्मक (Practical Examination) एवं अन्तरवार्ता (Interview)

पूर्णाङ्क: ८०

Part	Subject	Full Marks	Pass Marks	No. of Question x Marks	Time Allowed
I	Practical Examination	50	25	5 (Q) x 10 (M) = 50	45 Minutes
II	Interview	30	-	Oral	

द्रष्टव्यः

- लिखित परीक्षाको माध्यम भाषा नेपाली वा अंग्रेजी अथवा नेपाली र अंग्रेजी दुबै हुन सक्नेछ ।
- प्रथम पत्र र द्वितीय पत्रका पाठ्यक्रमका विषयवस्तु एउटै हुनेछ ।
- लिखित परीक्षा तथा प्रयोगात्मक परीक्षाका प्रश्नसंख्या निम्नानुसार हुनेछन् ।

प्रथम पत्रका इकाई	1	2	3	4	5	6	7	8	9	10	11	12	13
प्रश्न संख्या	5	4	5	5	7	3	5	2	1	3	5	3	2
द्वितीय पत्रका इकाई	1	2	3	4	5	6	7	8	9	10	11	12	13
द्वितीय पत्रका खण्ड	A						B						
प्रश्न संख्या	8						8						

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प्रयोगात्मक परीक्षाको इकाई	1	2	3	4	5	6	7	8	9	10	11	12	13
प्रश्न संख्या	-	-	-	1	2	1	1	-	-	-	-	-	-

४. बस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अंक कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अंक दिईने छैन र अंक कट्टा पनि गरिने छैन ।
५. बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको विद्युतीय उपकरण तथा क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।
६. बस्तुगत बहुवैकल्पिक प्रश्न (MCQs) को लागि एक उत्तरपुस्तिका हुनेछ । विषयगत प्रश्नका हकमा Short Answer को लागि एक र Long Answer को लागि एक उत्तरपुस्तिका हुनेछ ।
७. परीक्षार्थीले बहुवैकल्पिक प्रश्न र विषयगत प्रश्नहरूको उत्तर छुट्टाछुट्टै उत्तरपुस्तिकामा लेख्नु पर्नेछ ।
८. यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयबस्तुमा जेसुकै लेखिएको भएतापनि पाठ्यक्रममा परेका कानून, ऐन, नियम, विनियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाइएका वा थप गरी संशोधन भएका) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ ।
९. प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र द्वितीय चरणको अन्तरवार्तामा सम्मिलित गराइनेछ ।
१०. प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारको प्राप्ताङ्क र द्वितीय चरणको अन्तरवार्तामा प्राप्त गरेको अंक जोडी योग्यताक्रम अनुसार सिफारिस गरिनेछ ।
११. यो पाठ्यक्रम तुरुन्त लागू हुनेछ
१२. यस भन्दा अगाडि लागू भएको पाठ्यक्रम खारेज गरिएको छ ।

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पदपूर्ति समिति  
कम्प्युटर अधिकृत, टि-६ पद/तहको पाठ्यक्रम  
**Open and Internal Competition Examination**

**प्रथम र द्वितीय पत्र: कम्प्युटर सम्बन्धी**

**1. Computer Fundamentals**

- 1.1. Computer System, Classification of Computers
- 1.2. Generation of Computers
- 1.3. Components and Architecture of Computer, Connecting the Components
- 1.4. Getting started: Orientation to personal computers, The system unit, Starting the computers
- 1.5. Input Devices: The keyboard, The mouse, Other input devices
- 1.6. Processing: CPU, Memory
- 1.7. Storage devices: Overview of Storage Devices, The Floppy Disk Drive, The Hard Drive, The Universal Serial Bus(USB) Devices and Other Storage Devices
- 1.8. Output devices: Monitors, Printers, Modems, Soundcards
- 1.9. Software: Introduction, Types of Software, Using Application Software
- 1.10. Windows Explorer, E-mails, Internet, Intranet, Extranets, Ethernet, HTTP
- 1.11. Computer Security: Computer Viruses and Antivirus
- 1.12. Nepali Unicode, Nepali Fonts

**2. Data Structure and Algorithms**

- 2.1. Fundamentals of Data Structures, Abstract Data types
- 2.2. Lists, Linked Lists, Stacks
- 2.3. Queues, Priority Queue
- 2.4. Trees: Traversal, Implementations, Binary Trees, Binary Search Trees, Balanced Search Trees, AVL Trees
- 2.5. Indexing Methods. Hashing Trees, Suffix Trees
- 2.6. Worst-Case and Expected time Complexity
- 2.7. Analysis of Simple Recursive and Nonrecursive Algorithms
- 2.8. Searching, Merging and Sorting
- 2.9. Algorithm design: Divide-and-Conquer, Dynamic Programming, Greedy Methods, Backtracking
- 2.10. Graph algorithms: Depth-first Search and Breadth-first Search, Shortest Path Problems, Minimum Spanning Trees, Directed Acyclic Graphs

**3. System Analysis and Design**

- 3.1. Defining the System, System Owner, System User, System Designers and system Builders, System Analysts, Variations on the System Analyst title, System life Cycle
- 3.2. Joint Application Development (JAD): JAD definition, JAD purpose, JAD Philosophy, JAD Scope, Involved in a JAD: Sponsor, Business Users, System Analyst
- 3.3. Roles of JAD Group Member: Project Leader, Record Keeper, Time Keeper
- 3.4. The System Design Environment: Development Process, Management Process, System Structure, Basic Component of Computer based Information System, Personal/Centralized/Distribution System

- 3.5. Concept formations: Introduction, Finding the Problem, Evaluating the Proposal, Technical Feasibility, Operational Feasibility, Economic Feasibility
- 3.6. Requirements analysis: Representing System Analysis Model, Requirement Model, Design Model
- 3.7. Development Process: Design Method
- 3.8. Entity Relationship Diagram (E-R Diagram): Notations, Entities: Strong Entities, Weak Entities, Attributes: Simple and Composite, Single Valued and Multiple Valued, Null and Derived Attribute
- 3.9. Relationship Sets: Degree of Relationship and Cardinality Relationship, Specialization, Generalization, Aggregation
- 3.10. Data Flow Diagrams (DFDs): Introductions, Data flow Diagram, Symbol, Files or data store, External entities, Data flows, Context diagram, Top level DFD, Expansion Level DFD, Conversions of Data
- 3.11. Object Modeling: Object-Oriented Concept, Object Structure, Object Feature, Class and Object
- 3.12. Representation: Association and Composition, Inheritance, Multiple Inheritances
- 3.13. Modeling: Use Case Diagram, State Diagram, Event Flow Diagram
- 3.14. Documentation: Automatic and Manual System

#### **4. Operating Systems**

- 4.1 Definition of an Operating System, Trace the Developments in Operating Systems, Functions of Operating Systems, Types of Operating Systems
- 4.2 Basic components of the Operating Systems, Understand Information Storage and Management Systems
- 4.3 Disk Allocation and Scheduling Methods, Basic Memory Management strategies, Virtual Memory Management Techniques, Process and the features of the Process Management System
- 4.4 Features of Process Scheduling; features of Inter-Process Communication and Deadlocks
- 4.5 Concepts of Parallel and Distributed Processing, Security Threats to Operating Systems
- 4.6 Overview of the MS-DOS Operating System, Using Command Prompt, Internal and External commands, Creating and using AUTOEXEC.BAT and CONFIG.SYS
- 4.7 Introduction to the Windows Family of Products, Unix Family of Products, Linux Family of Products
- 4.8 Windows survival guide: The Windows Desktop, The Program Manager, Organizing the Desktop, The File Manager, Introduction to Windows Networking, Monitoring and Troubleshooting Windows
- 4.9 Windows Architecture and Linux Architecture
- 4.10 Troubleshooting Windows & Linux
- 4.11 Managing Network Printing
- 4.12 Managing Hard Disks and Partitions
- 4.13 Users, Groups and Permission on Linux and Windows

#### **5. Database Management System and Design**

- 5.1. Introduction, a Database Model, Relational Database Model, Integrity, RDBMS
- 5.2. SQL and Embedded SQL
- 5.3. Writing Basic SQL SELECT Statements

- 5.4. Restricting and Sorting data
- 5.5. Single Row Functions
- 5.6. Displaying Data from Multiple Tables
- 5.7. Aggregation Data Using Group Functions
- 5.8. Sub Queries, Manipulating Data and Creating & Managing Tables
- 5.9. Creating Views and Controlling User Access
- 5.10. Using Set Operators, Datetime Function
- 5.11. Database Design: Logical Design, Conceptual Design, Mapping Conceptual to Logical, Pragmatic issues, Physical Design, Integrity and Correctness, Relational Algebra, Relational Calculus
- 5.12. Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF, DKNF
- 5.13. Architecture of DBMS: Client-server, Open Architectures, Transaction Processing, Multi-User & Concurrency, and Backup & Recovery Database
- 5.14. Basic Concept of major RDBMS products: Oracle, Sybase, DB2, SQL Server and other Databases

## **6. Programming Language**

- 6.1. Overview of Programming Language: History, Programming Paradigms, The role of Language translators in the Programming Process
- 6.2. Fundamental Issues in Language Design
- 6.3. Virtual Machines, Code Generation, Loop Optimization
- 6.4. Concept of Procedural Programming, Structural Programming, Object-Oriented Programming
- 6.5. Programming with C, C++ and Java

## **7. Networking**

- 7.1. Basic Network Theory: Network Definition, Network Models, Connectivity, Network Addressing
- 7.2. Network Connectivity: The Data Package, Establishing a Connection, Reliable Delivery, Network Connectivity, Noise Control, Building Codes, Connection Devices
- 7.3. Advanced Network Theory: The OSI model, Ethernet, Network Resources, Token ring, FDDI, Wireless Networking
- 7.4. Common Network Protocols: Families of Protocols, NetBEUI, Bridge and Switches, The TCP/IP Protocol, Building TCP/IP Network, The TCP/IP Suite
- 7.5. TCP/IP Services: Dynamic Host Configuration Protocol, DNS Name Resolution, NetBIOS support, SNMP, TCP/IP Utilities, FTP
- 7.6. Network LAN Infrastructure: LAN Protocols on a Network, IP Routing, IP Routing Tables, Router Discovery Protocols, Data Movement in a Routed Network, Virtual LANs (VLANs)
- 7.7. Network WAN Infrastructure: The WAN Environment, Wan Transmission Technologies, Wan Connectivity Devices, Voice Over Data Services
- 7.8. Remote Networking: Remote Networking, Remote Access protocols, VPN Technologies
- 7.9. Network Security: Introduction, Virus Protection, Local Security, Network Access, Internet Security
- 7.10. Disaster Recovery: The need for Disaster Recovery, Disaster Recovery plan, Data backup, Fault Tolerance

- 7.11. Advanced Data Storage Techniques: Enterprise Data Storage, Clustering, Network Attached Storage, Storage Area Networks
- 7.12. Network Troubleshooting: Using Systematic Approach to Troubleshooting
- 7.13. Network Support Tools: Utilities, the Network Baseline
- 7.14. Network Access Points (NAP), Common Network Component, Common Peripheral Ports

## **8. Computer Architecture & Organization**

- 8.1. Evaluation of Computers, Design Methodology, Set Architecture, MIPS ISA, ALU Design
- 8.2. Datapath Design: Single and Multiple Cycle Implementations, Pipelining, Memory Hierarchy, Input/Output System: Bus & Role of Operating System

## **9. Compiler Design**

- 9.1. Introduction to Compiling
- 9.2. Logical Analysis, Syntax Analysis, Semantic Analysis
- 9.3. Run Time environment
- 9.4. Intermediate Code Generation, Code Optimization
- 9.5. Compiler Generation Tools

## **10. E-Commerce Technology**

- 10.1. Introduction to E-Commerce
- 10.2. Electronic Commerce Strategies
- 10.3. Electronic Commerce Security Issues
- 10.4. Success Models of E-Governance
- 10.5. E-Business: b2b, b2c, b2e, c2c, g2g, g2c
- 10.6. Principles of Electronic Payment, Strategies & Systems
- 10.7. E-marketing, Reverse Engineering
- 10.8. E-Banking, EDI Methods, SWIFT
- 10.9. Encryption and Decryption Methods, XML, Layout Managers, Event Model

## **11. MIS and Web Engineering**

- 11.1. Information Systems, Client-Server Computing
- 11.2. Information Systems and Decision Making
- 11.3. Database Design issues, Data Mining, Data Warehousing
- 11.4. Knowledge Management, The strategic use of Information Technology
- 11.5. Work Process Redesign (Reengineering) with Information Technology, Enterprise Resources Planning Systems, Information Systems Security, Information Privacy, and Global Information Technology issues
- 11.6. Software Supported Demonstrations including advanced Spreadsheet topics, Software Component Based Systems (CBSE)
- 11.7. Multimedia
- 11.8. Object-Oriented Programming with COMS & DECOMS
- 11.9. Group Decision Support Systems
- 11.10. Basics of Website Design

## 12. IT in Nepal

- 12.1. History of IT in Nepal
- 12.2. ICT Policy of Nepal, 2072 B.S
- 12.3. Electronic Transaction Act, 2063 B.S
- 12.4. Copyright Act, 2059 B.S
- 12.5. Licensing Issues

## 13. Others

- 13.1. NARC Act and Administration and Financial By-Laws
- 13.2. Public Procurement Act/Regulations

### प्रयोगात्मक परीक्षाको नमूना प्रश्नहरू

1. Get IP address from given computers which are Network
  - a. Give privileged share only data base administration
  - b. Determine if the following address are on local or remote network  
Node 1: 192.255.16.8  
Node 2: 192.225.14.8  
Mask: 255.255.255.0
2. Create tables Student, Teacher, Course is SQL  
Student (Sid, Sname, subject, level) Teacher  
(Tid, Tname, subject,)  
Course (Cid, Cnumber, Tname, level)
  - a. Insert 10 values
  - b. Delete first two values
3. Given a string  
String S("123456789")  
Write a program in C++ that displays the following:

1  
232  
34543  
4567654  
567898765



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ईञ्जिनियर, टि-६ पद/तहको खुला तथा आन्तरिक प्रतियोगितात्मक  
लिखित परीक्षाको पाठ्यक्रम एवं परीक्षा योजना

यस पाठ्यक्रम योजनालाई दुई चरणमा विभाजन गरिएको छ।

प्रथम चरण: लिखित परीक्षा (Written Examination)

पूर्णाङ्क: २००

द्वितीय चरण: अन्तरवार्ता (Interview)

पूर्णाङ्क: ३०

१. प्रथम चरण: लिखित परीक्षा (Written Examination)

पूर्णाङ्क: २००

पत्र	विषय	पूर्णाङ्क	उत्तिर्णाङ्क	परीक्षा प्रणाली	प्रश्न संख्या x अंक	समय
प्रथम	सामान्य ज्ञान तथा सामाजिक अध्ययन	१००	४०	बस्तुगत	५० प्रश्न x २ अंक = १०० बहुवैकल्पिक प्रश्न (MCQs)	४५ मिनेट
द्वितीय	सेवा सम्बन्धी	१००	४०	विषयगत	८ प्रश्न x ५ अंक = ४० (छोटो उत्तर) ६ प्रश्न x १० अंक = ६० (लामो उत्तर)	३ घण्टा

२. द्वितीय चरण: अन्तरवार्ता एवं सिप परीक्षण (Skill Test & Interview)

पूर्णाङ्क: ३०

विषय	पूर्णाङ्क	परीक्षा प्रणाली	समय
अन्तरवार्ता (Interview)	३०	मौखिक	

द्रष्टव्य:

- यो पाठ्यक्रम योजनालाई प्रथम चरणमा लिखित परीक्षा र द्वितीय चरणमा अन्तरवार्ता परीक्षा गरी दुई चरणमा विभाजन गरिएको छ।
- प्रशासन र लेखा समूहको समान पद/तहको सामान्य ज्ञान तथा सामाजिक अध्ययन खण्ड (क) को पाठ्यक्रम एउटै भएको कारण एकिकृत परीक्षा सञ्चालन हुनेछ।
- बस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरूको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अंक कट्टा गरिनेछ। तर उत्तर नदिएमा त्यस बापत अंक दिइने छैन र अंक कट्टा पनि गरिने छैन।
- बहुवैकल्पिक प्रश्नहरू हुने परीक्षामा कुनै प्रकारको विद्युतीय उपकरण तथा क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन।
- बस्तुगत बहुवैकल्पिक प्रश्न (MCQs) को लागि एक उत्तरपुस्तिका हुनेछ। विषयगत प्रश्नका हकमा दुई वटा (Short Answer को लागि एक तथा Long Answer को लागि एक) उत्तरपुस्तिकाहरू हुनेछन्।
- प्रत्येक खण्डका लागि छुट्टाछुट्टै उत्तरपुस्तिकाहरू हुनेछन्। परीक्षार्थीले प्रत्येक खण्डका प्रश्नहरूको उत्तर सोही खण्डको उत्तरपुस्तिकामा लेख्नु पर्नेछ।
- यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयबस्तुमा जेसुकै लेखिएको भएतापनि पाठ्यक्रममा परेका कानून, ऐन, नियम, विनियम तथा नीतिहरू परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाइएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्यक्रममा परेको सम्झनु पर्दछ।
- प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारहरूलाई मात्र द्वितीय चरणको अन्तरवार्तामा सम्मिलित गराइने छ।
- प्रथम चरणको लिखित परीक्षाबाट छनौट भएका उम्मेदवारको प्राप्ताङ्क र द्वितीय चरणको अन्तरवार्तामा प्राप्त गरेको अंक जोडी योग्यताक्रम अनुसार सिफारिस गरिनेछ।
- यो पाठ्यक्रम तुरुन्त लागू हुनेछ।
- यस भन्दा अगाडि लागू भएको पाठ्यक्रम खारेज गरिएको छ।

इंजिनियर, टि-६ पद/तहको खुला तथा आन्तरिक प्रतियोगितात्मक  
लिखित परीक्षाको पाठ्यक्रम

**प्रमथ पत्र:**

सिभिल इंजिनियरिङ सम्बन्धी

**1. Structure Analysis and Design**

- 1.1 Stresses and strains; theory of torsion and flexure; moment of inertia
- 1.2 Analysis of beams and frames: Bending moment, shear force and deflection of beams and frames: determinate structure- Energy methods; three hinged systems, indeterminate structures- slope deflection method and moment distribution method; use of influence line diagrams for simple beams, unit load method
- 1.3 Reinforced concrete structures: Difference between working stress and limit state philosophy, analysis of RC beams and slabs in bending, shear, deflection, bond and end anchorage, Design of axially loaded columns; isolated and combined footings, introduction to pre-stressed concrete
- 1.4 Steel and timber structures: Standard and built-up sections: Design of riveted, bolted and welded connections, design of simple elements such as ties, struts, axially loaded and eccentric columns, column bases, Design principles on timber beams and columns

**2. Construction Materials**

- 2.1 Properties of building materials: physical, chemical, constituents, thermal
- 2.2 Stones-characteristics and requirements of stones as a building materials
- 2.3 Ceramic materials: ceramic tiles, Mosaic Tile, brick types and testing
- 2.4 Cementing materials: types and properties of lime and cement; cement mortar tests
- 2.5 Metals: Steel; types and properties; Alloys
- 2.6 Timber and wood: timber trees in Nepal, types and properties of wood
- 2.7 Miscellaneous materials: Asphaltic materials (Asphalt, Bitumen and Tar); paints and varnishes; polymers
- 2.8 Soil properties and its parameters

**3. Concrete Technology**

- 3.1 Constituents and properties of concrete (physical and chemical)
- 3.2 Water cement ratio
- 3.3 Grade and strength of concrete, concrete mix design, testing of concrete
- 3.4 Mixing, transportation pouring and curing of concrete
- 3.5 Admixtures
- 3.6 High strength concrete
- 3.7 Pre-stressed concrete technology

**4. Construction Management**

- 4.1 Construction scheduling and planning: network techniques (CPM, PERT) and bar charts
- 4.2 Contractual procedure and management: types of contract, tender and tender notice, preparation of bidding (tender) document, contractors pre-qualification, evaluation of tenders and selection of contractor, contract acceptance, condition of contract; quotation and direct order, classifications of contractors; dispute resolution

- 4.3 Material management: procurement procedures and materials handling
  - 4.4 Cost control and quality control
  - 4.5 Project maintenance
  - 4.6 Occupational health and safety
  - 4.7 Project monitoring and evaluation
  - 4.8 Quality assurance plan
  - 4.9 Variation, alteration and omissions
- 5. Estimating and Costing, Valuation and Specification**
- 5.1 Types of estimates and their specific uses
  - 5.2 Methods of calculating quantities
  - 5.3 Key components of estimating norms and rate analysis
  - 5.4 Preparation of bill of quantities
  - 5.5 Purpose, types and importance of specification
  - 5.6 Purpose, principles and methods of valuation
- 6. Drawing Techniques**
- 6.1 Drawing sheet composition and its essential components
  - 6.2 Suitable scales, site plans, preliminary drawings, working drawings
  - 6.3 Theory of projection drawing: perspective, orthographic and axonometric projection; first and third angle projection
  - 6.4 Drafting tools and equipments
  - 6.5 Drafting conventions and symbols
  - 6.6 Topographic, electrical, plumbing and structural drawings
  - 6.7 Techniques of free hand drawing
- 7. Engineering Survey**
- 7.1 Introduction and basic principles
  - 7.2 Linear measurements: techniques; chain, tape, ranging rods and arrows; representation of measurement and common scales; sources of errors; effect of slope and slope correction; correction for chain and tape measurements; Abney level and clinometers
  - 7.3 Compass and plane table surveying: bearings; types of compass; problems and sources of errors of compass survey; principles and methods of plane tabling
  - 7.4 Leveling and contouring: Principle of leveling; temporary and permanent adjustment of level; bench marks; booking methods and their reductions; longitudinal and cross sectioning; reciprocal leveling; trigonometric leveling; contour interval and characteristics of contours; methods of contouring
  - 7.5 Theodolite traversing: need of traverse and its significance; computation of coordinates; adjustment of closed traverse; closing errors
  - 7.6 Uses of Total Station and Electronic Distance Measuring Instruments
- 8. Engineering Economics**
- 8.1 Benefit cost analysis, cost classification, sensitivity analysis, internal rate of return, time value of money; economic equilibrium, demand, supply and production, net present value, financial and economic evaluation
- 9. Professional Practices**

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- 9.1 Ethics and professionalism: code of conduct and guidelines for professional engineering practices
- 9.2 Nepal Engineering Council Act, 2055 and regulations, 2056
- 9.3 Relation with clients, contractor and fellow professionals
- 9.4 Public procurement practices for works, goods and services and its importance

**द्वितीय पत्रः**  
जनरल विषय सम्बन्धी

**Section (A)**

**1. Transportation and Roads**

- 1.1 Transportation system and its classification
- 1.2 Transportation planning: rationale, types and its philosophy
- 1.3 Road transport and road construction in Nepal
- 1.4 Classification of roads in Nepal (NRS and IRC)
- 1.5 General principles of road network planning
- 1.6 Feasibility study of road projects
- 1.7 Alignment, engineering survey and its stages
- 1.8 Geometric design of roads: map study, element of cross-section and highway alignment, design of horizontal curve, superelevation, transition curve, vertical curves, right of way
- 1.9 Drainage consideration in roads:
  - 1.9.1 Introduction and design of culverts and minor bridges, cross drainage structures, sub surface drainage system
- 1.10 Special consideration in Hill roads design:
  - 1.10.1 Problems associated with hill roads construction
  - 1.10.2 Route location, hairpin bends and special structures
- 1.11 Road Pavement: Types of pavement and their applicability in hill roads, Design of pavement
- 1.12 Bioengineering practices along hill side
- 1.13 Activities and techniques in road construction in rural roads
- 1.14 Maintenance, repair and rehabilitation of roads
- 1.15 Role of social mobilization in rural road development.
- 1.16 Low-cost road construction

**2. Housing, Building and Urban Planning:**

- 2.1 Present status and practices of building construction in Nepal
- 2.2 Specific considerations in design and construction of buildings in Nepal
- 2.3 Indigenous technology in building design and construction
- 2.4 Local and Modern building construction material in Nepal
- 2.5 Community buildings: School and hospital buildings and their design considerations
- 2.6 Urban planning needs and challenges in Nepal

**Section (B)**

**1. Water Supply and Sanitation**

- 1.1 Rural and community based water supply system

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पदपूर्ति समिति

- 1.2 Water supply sources and their management
    - 1.2.1 Surface water
    - 1.2.2 Ground water
  - 1.3 Selection of source
  - 1.4 Water quality and treatment, water demand and supply, source protection
  - 1.5 Intakes, collection chamber and break pressure tanks
  - 1.6 Reservoir and distribution system
  - 1.7 Intakes, Pipeline design, design of transmission and distribution system, reservoir design
  - 1.8 Pipe and fittings: Pipe materials, pipe laying and fittings
  - 1.9 Operation and maintenance of water supply systems
  - 1.10 Sanitation, waste water and solid waste management:
    - 1.10.1 On-site sanitation system
    - 1.10.2 Types of sewerage system, design and construction of sewers
    - 1.10.3 Types, characteristics, sources, quantity, generation, collection, transportation and disposal of solid wastes
    - 1.10.4 Sanitary landfill, incineration, composting
  - 1.11 Environmental health engineering - Epidemiology, pathogens (Bacteria, Virus, Helminthes, Protozoa)
- 2. Irrigation**
- 2.1 Status of irrigation development in Nepal
  - 2.2 Methods of irrigation and their suitability
  - 2.3 Operation and maintenance of irrigation systems
  - 2.4 Management of Farmers managed irrigation system
  - 2.5 Preventive and remedial measures of water logging
  - 2.6 Flood control, its necessity and flood mitigation measures
- 3. NARC General:**
- 3.1 NARC Act and Administration and Financial By-Laws
  - 3.2 Public Procurement Act/Regulations

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