अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

| S. No. | विषय (Subject) | S. No. | विषय (Subject) | S. No. | विषय (Subject) |
|-----------|-------------------|-----------|-----------------------|-----------|--------------------------|
| 001 | Account & Finance | 007 | Environmental science | 013 | Political Science |
| 002 | Agriculture | 008 | Forestry | 014 | Population studies |
| 003 | Botany | 009 | Health science | 015 | Public Administration |
| 004 | Economics | 010 | Law | 016 | Sociology & Anthropology |
| 005 | Education | 011 | Microbiology | 017 | Zoology |
| 006 | Engineering | 012 | Physics | 018 | Chemistry |

ऐच्छिक विषयहरुको सूची (List of Optional Papers)

- ऐच्छिक विषय माथि तालिकामा दिइएका मध्ये जुनसुकै एक विषय छनौट गर्न सकिनेछ । उम्मेदवारले फाराम भर्दा फाराममा निर्दिष्ट गरिएको ठाउँहरुमा आफूले परीक्षा दिने ऐच्छिक विषय अनिवार्य रुपमा उल्लेख गर्नु पर्नेछ ।
- चतुर्थ पत्र ऐच्छिक विषयको लिखित परीक्षामा प्रश्न पत्रहरुको माध्यम भाषा निम्न विषयहरुको हकमा नेपाली र अंग्रेजी दुवै हुनेछ ।

| S. No. | विषय (Subject) | S. No. | विषय (Subject) |
|--------|-------------------|--------|--------------------------|
| 001 | Account & Finance | 013 | Political Science |
| 004 | Economics | 014 | Population studies |
| 005 | Education | 015 | Public Administration |
| 010 | Law | 016 | Sociology & Anthropology |

 चतुर्थ पत्र ऐच्छिक विषयको लिखित परीक्षामा प्रश्न पत्रहरुको माध्यम भाषा निम्न विषयहरुको हकमा अंग्रेजी मात्र हनेर्छ ।

| S. No. | विषय (Subject) | S. No. | विषय (Subject) |
|--------|-----------------------|--------|----------------|
| 002 | Agriculture | 009 | Health science |
| 003 | Botany | 011 | Microbiology |
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| 008 | Forestry | 018 | Chemistry |

- वस्तुगत बहुवैकल्पिक (Multiple Choice) प्रश्नहरुको गलत उत्तर दिएमा प्रत्येक गलत उत्तर बापत २० प्रतिशत अङ्क कट्टा गरिनेछ । तर उत्तर नदिएमा त्यस बापत अङ्क दिइने छैन र अङ्क कट्टा पनि गरिने छैन ।
- बहुवैकल्पिक प्रश्नहरु हुने परीक्षामा कुनै प्रकारको क्याल्कुलेटर (Calculator) प्रयोग गर्न पाइने छैन ।
- यस पाठ्यक्रम योजना अन्तर्गतका पत्र/विषयका विषयवस्तुमा जेसुकै लेखिएको भए तापनि पाठ्यक्रममा परेका कानून, ऐन, नियम तथा नीतिहरु परीक्षाको मिति भन्दा ३ महिना अगाडि (संशोधन भएका वा संशोधन भई हटाईएका वा थप गरी संशोधन भई) कायम रहेकालाई यस पाठ्कममा परेको सम्भन् पर्दछ ।
- निम्न ऐच्छिक विषयहरुका पाठ्यक्रम र नमुना प्रश्नहरु यसमा संलग्न गरिएको छ । बाँकी विषयहरुका पाठ्यक्रम र नमुना प्रश्नहरु अर्को PDF file संलग्न गरिएको छ ।

| S. No. | विषय (Subject) | S. No. | विषय (Subject) |
|--------|-----------------------|--------|----------------|
| 002 | Agriculture | 009 | Health science |
| 003 | Botany | 011 | Microbiology |
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अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठ्यकम

Paper IV: Optional Paper (002) – Agriculture

Section A - 30 Marks

1. General Agriculture

- 1.1 History of agriculture development in Nepal
- 1.2 Importance of agriculture in Nepalese economy
- 1.3 Agriculture Perspective Plan (1995-2015) and current periodic plan
- 1.4 Multi-sector nutrition plan of the government and priority actions in agriculture
- 1.5 National Adaptation Plan of Action (NAPA) 2010 of GoN and priorities and strategies for agriculture sector
- 1.6 National Agriculture Policy 2061
- 1.7 Implications of the WTO membership in the Nepalese agriculture; Sanitary and Phyto-sanitary measures, Agreement on Agriculture, Technical barriers to trade and intellectual property rights

1.8 Convention on bio-diversity

2. Agronomy, Soil science, Plant breeding, and Climate change

- 2.1 Importance of cereals (rice, wheat, maize) and their role in food security
- 2.2 Importance of pulses (lentil, soybean, blackgram, mungbean) and oil seeds (rapeseed and mustard) and their role in nutritional security
- 2.3 Importance of fiber and sugar crops, and their released varieties
- 2.4 Released varieties of cereals; rice, wheat, maize
- 2.5 Released varieties of pulses (lentil, soybean, blackgram, mungbean)
- 2.6 Released varieties of oilseeds (rapeseed and mustard)
- 2.7 Production practices for cereals (rice, wheat, maize), pulses (lentil, soybean) and oilseeds (rapeseed and mustard)
- 2.8 Seed and seed productions techniques
- 2.9 Food safety, concept of integrated pest management, integrated crop management, integrated plant nutrient system, agro-biodiversity, conservation and utilization
- 2.10 Importance and principles of diseases, pests and pesticide management
- 2.11 Genetic basis of plant breeding, pure line selection, mass selection, their use in plant breeding
- 2.12 Minerals and organic constituents of soil and their role in crops production
- 2.13 Essential plant nutrients
- 2.14 Organic manures and bio- fertilizer.
- 2.15 Inorganic fertilizers and their nutrient contents
- 2.16 Effect of global warming, land slide, drought, flood, cold spell in agriculture and their mitigation
- 2.17 Importance of temperature, rainfall, wind pressure, solar radiation, evapotranspiration and relative humidity in agriculture

3. Horticulture

- 3.1 History and constraints of horticulture development in Nepal
- 3.2 Role of horticulture in food security, nutrition security, environmental security, and health security

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

- 3.3 Area and production, exports and imports of horticultural crops; fruits and vegetables zones of Nepal
- 3.4 Establishment of different horticultural enterprises, care and management
- 3.5 Sexual and asexual methods of plant propagation.
- 3.6 Intercropping, mixed cropping, multistory cropping, companion cropping in horticulture
- 3.7 Training and pruning of horticultural crops
- 3.8 Nutrient management and fertilizer uses in horticulture
- 3.9 Fruit and vegetable preservation methods
- 3.10 Post-harvest handling and storage of horticultural produce
- 3.11 Production practices of following horticultural crops;
 - 3.11.1 Fruits mango, banana, papaya, citrus, guava, litchi, apple, peach, walnut, and grapes
 - 3.11.2 Vegetables potato, tomato, brinjal, okra, chilly, beans, cowpeas, peas, cucumber, watermelon, cabbage, cauliflower, broccoli, broad leaf mustard, spinach, radish, carrot, garlic, and onion
 - 3.11.3 Plantation crops tea , coffee and cardamom
 - 3.11.4 Flowers rose, gladiolus, chrysanthemum, dahlia, and marigold)
 - 3.11.5 Seed production techniques and marketing of rayo, radish, tomato, onion, cauliflower, cabbage, okra, beans, peas and flowers
 - 3.11.6 Important diseases and pests of above crops and their control measures

4. Agriculture Extension and Economics

- 4.1 Agricultural extension approaches/ models used in Nepal
- 4.2 Principles of extension education and their applications
- 4.3 Agricultural extension program planning; meaning and steps in agricultural extension planning in Nepal
- 4.4 Extension teaching methods; individual, group and mass methods
- 4.5 Communication process; meaning, importance and basic elements of communication process
- 4.6 Importance of linkages between research and extension system for agriculture development
- 4.7 Innovation decision process (adoption process); stages of adoption process, adopters categories and factors affecting the rate of adoption
- 4.8 Some basic concepts used in agricultural extension; government led agricultural extension, NGO led agricultural extension, farmers led agricultural extension, one village one product, pocket package program, institution pluralism, gender mainstreaming in agriculture and farmer to farmer extension
- 4.9 Agriculture economics: meaning and scope
- 4.10 Farm management: meaning and scope, farm planning, farm budgeting, enterprise budgeting, farm inventory, farm efficiency measures, farm records, farm accounts, farm prices
- 4.11 Law of demand, law of supply and elasticity of supply
- 4.12 Law of diminishing marginal utility
- 4.13 Agricultural marketing in Nepal; nature of marketing, marketing channels and problems of agricultural marketing

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

Section B - 20 Marks

5. Animal Husbandry, Dairy and Fisheries

- 5.1 Relation of plants, animals and human beings
- 5.2 Scio-economic aspects of livestock and poultry enterprises
- 5.3 Breeds of livestock and poultry
- 5.4 Genetics resource of Nepal and importance of heredity and environment.
- 5.5 Male and female reproduction system, estrus cycle and estrus detection
- 5.6 Artificial insemination for breed improvement
- 5.7 Relation of food and nutrition to health
- 5.8 Role of nutrition in animal health and animal production
- 5.9 Classification, functions and deficiency symptoms of nutrients
- 5.10 Importance of fodder production and pasture management
- 5.11 Common pasture species and cultivars
- 5.12 Preservation and conservation of feeds and fodders
- 5.13 Difference between ruminant and non-ruminant
- 5.14 Systems of housing and management of livestock and poultry
- 5.15 Animal restraining, handling, ageing, weighing, identification, castration, dehorning, grooming, dipping, dusting and shearing
- 5.16 Care and management of different species of farm animals in different physiological state
- 5.17 Selection and judging of farm animals
- 5.18 Milking methods and clean milk production
- 5.19 Physicochemical and nutritional properties of milk
- 5.20 Common tests and legal standards of milk
- 5.21 Cleaning and sanitation of dairy equipment
- 5.22 Milk collection, chilling and transportation
- 5.23 Manufacturing of market milk and common dairy products
- 5.24 Role of micro-organisms in quality of milk and milk products
- 5.25 Economic importance of fish farming and economically important fishes of Nepal
- 5.26 Fish farming systems; fish breeding, water quality and its management
- 5.27 Common fish diseases

6. Veterinary Science

- 6.1 Role of public and private sector in the promotion of veterinary services in Nepal
- 6.2 General clinical examinations of animals
- 6.3 Normal physiological values like body temperature, rectal temperature, heart rates, respiratory rates of different species of animals
- 6.4 Normal reproductive cycle of different farm animals
- 6.5 Deficiency diseases of livestock and poultry
- 6.6 Methods of immunization and breakdown of immunity
- 6.7 Vaccine and their use in animals
- 6.8 Zoonosis, food borne infections, intoxications and occupation hazards
- 6.9 Principles of antiseptics, sterilization and disinfection
- 6.10 Common bacterial, viral, parasitic and fungal diseases of cattle, buffalo, sheep, goat, pig and poultry in Nepal
- 6.11 General function and mechanism of action of various organs of circulatory, digestive, respiratory, urinary, endocrine system of domesticated animals and birds

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अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

| Uni | | | Weight | No of | Sp | ecification |
|----------|--|---------|--------|-------|--------------------|--------------------------|
| t No. | Contents Title | Section | age | items | I - Level (60%) | II & III -Level (40%) |
| 1. | General Agriculture | | | | | |
| 2. | Agronomy, Soil science, Plant breeding, and Climate change | А | 15 | 15 | 9 | 6 |
| 3. | Horticulture | | | | | |
| 4. | Agriculture Extension and Economics | | 15 | 15 | 9 | 6 |
| 5. | Animal Husbandry, Dairy and Fisheries | В | 10 | 10 | 6 | 4 |
| 6. | Veterinary Science | | 10 | 10 | 6 | 4 |
| | Total | | 50 | 50 | 30 | 20 |

Table of Specification

Paper IV: Optional Paper - Sample MCQs of Agriculture

I - Level Questions

- 1.Letting down of milk in dairy cow is governed by which of the following hormone?
A) EstrogenB) OxytocinC) ThyroxinD) Progesterone
- 2. The method of water treatment for dairy plant which is most effective and economical is
 - A) Pasteurization of waterB) Filtration through special filtersD) Light treatment
- 3.The enzyme used in cheese making is.....A) RenninB) PepsinC) PtyalinD) Lipase

II & III - Level Questions

- 4. Capital (WW) represents for dominant gene for white and small (ww) represents for recessive gene for colour. when heterozygous white Ww female is crossed with ceterozygous while (Ww) male. the following results of cross are observed
 - a. 2 offspring are white
 - b. 1 offspring is coloured
 - c. 1 offspring is homozygous white

Identify which of the above statements are correctA) a and bB) a and cC) a and dD) b and c

- 5. Identify the proper sequence of the steps involved in a learning process from the following:
 - A) Interest -> Attention-> Desire -> Conviction -> Action -> Satisfaction
 - B) Attention -> Interest -> Desire -> Conviction -> Action -> Satisfaction
 - C) Interest -> Desire -> Attention-> Conviction -> Action -> Satisfaction
 - D) Attention-> Desire -> Interest -> Conviction -> Action -> Satisfaction

| | | | लोक सं | वा आयोग | | | | | |
|------|---------------------------|---------------------|----------------------------------|--------------|-----------------|------------|-----------|--------|--------|
| अप्र | ाविधिक (न्याय, परराष्ट्र, | , प्रशासन, लेखापरीध | भण र संसद सेवा), र | राजपत्रांकित | । तृतीय श्रेण | गी, शाखा अ | 1धिकृत वा | सो सरह | ऽ पदको |
| | | खुल | । प्रतियोगितात्मक प ^र | रीक्षाको पात | ड् यक्रम | | | | |
| 6. | "Pineapple" is a | a variety avail | able in two of | the follo | owing fr | uits: | | | |
| | a. Apple | b. Mango | c. Sweet or | ange | d. Pi | neapple | | | |
| | A) a & b | B) b & c | C) c & d | D) a | & c | | | | |
| 7. | Which of the fo | ollowing fruit | type is correctl | y match | ed? | | | | |
| | a. Pea. | C | 1. Pe | od. | | | | | |
| | b. Okra. | | 2. C | apsule. | | | | | |
| | c. Carrot. | | 3. So | chizocar | p. | | | | |
| | | | 4. Si | iliqua. | | | | | |
| | A) a-2, b-1, & | & c-4. | | | | | | | |
| | B) a-4, b-3, & | & c-2. | | | | | | | |
| | C) a-1, b-2, & | & c-3. | | | | | | | |
| | D) a-3, b-4, 8 | & c-1. | | | | | | | |
| 8. | Protein contain | of feeds used | in poultry feed | ling | | | | | |
| | Deeds | | 1 2 | Prot | ein (%) | | | | |
| | 1. Yellow maiz | ze | | a. 12 | | | | | |
| | 2. Rice polish | | | b. 9.9 | 9 | | | | |
| | 3. Soyabean | | | c. 61 | 2 | | | | |
| | 4. Fish meal | | | a. 44 | H.4 | | | | |
| | A) 1-b, 2-a, 3-d | l, 4-c | | | | | | | |
| | B) 1-a, 2-b, 3-c | e, 4-d | | | | | | | |

- 9. Read the following statements and identify the correct and incorrect ones:
 - 1. Short day plants flower with night longer than the critical night length.
 - 2. Long day plants flower with night longer than the critical night length.
 - 3. Long day plants flower with night shorter than the critical night length.
 - A) All 1, 2, and 3 statements are correct.

C) 1-c, 2-d, 3-a, 4-b D) 1-a, 2-b, 3-d, 4-c

- B) All 1, 2, and 3 statements are incorrect.
- C) 1 and 3 are correct but 2 is incorrect.
- D) 1 and 3 are incorrect but 2 is correct.
- 10. Stem cutting is the most common type of propagation in horticultural plant species. Which of the following statements are correct about their different stem cutting types?
 - 1. Hardwood cuttings are used commonly in roses.
 - 2. Semi-hardwood cuttings are used in crotons.
 - 3. Herbaceous cuttings are used in grapes.
 - 4. Softwood cuttings are used in plums.
 - A) 1 & 2 are correct, but 3 & 4 are incorrect.
 - B) 1 & 3 are correct, but 2 & 4 are incorrect.
 - C) 2 and 3 are correct, but 1 & 4 are incorrect.
 - D) 3 & 4 are correct, but 1 & 2 are incorrect

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

11. Match the following categories of adopters in an innovation-decision process, their adoption behaviour and key characteristics

| Adopters' catego | <u>ries</u> <u>A</u> | doption behaviour | Key characteristics |
|-------------------|----------------------|--|---|
| a. Innovators | 1 | . Adopt an innovation just | i. Have less contact with |
| | | before the average members of the community | cosmopolite sources of information |
| b. Early majority | y 2. | . Last to adopt an innovation | ii. Venturesome |
| c. Laggards | 3. | . First to adopt an innovation | iii. Tend to be suspicious of innovations |
| A) a − 1 − ii, | b - 2 - it | ii, $c-2-i$ | |
| B) $a - 2 - i$, | b - 2 - it | ii, $c-3-ii$ | |
| C) a − 3 − ii, | b - 1 - i | , $c-2-iii$ | |
| D) a − 2 − iii, | b – 3 – i | , c – 2 - ii | |

- 12. Match the following deficiency symptoms/ diseases with different minerals and vitamins in different animal and poultry species
 - a. Curled toe paralysis
- 1. Riboflavin
- b. Anemia 2. Iron 3. Magnesium
- c. Grass titany
- i. Chicks ii. Piglets iii. Dairy cattle

- a-1-i, b-2-ii, c-3-iii A)
- B) a-2-iii, b-1-i, c-2-ii
- C) a-3-ii, b-2-iii, c-1-i
- a-3-iii, b-1-ii, c-2-i D)

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Paper IV: Optional Paper (003) – Botany Section A - 25 Marks

1. Virus, Bacteria and Fungi

- 1.1. Characteristics, classification, reproduction and economic importance of bacteria
- 1.2. Characteristics, structure, life cycles and classification of phycomycotina (*Albugo*), Ascomycotina (*Aspergillus* and *Saccharomyces*), Basidiomycotina (*Agaricus*) and Deuteromycetes (*Alternaria*), Vesicular Arbuscular Mycorrhizae. Economic importance of fungi
- 1.3. gconcept, structure, chemical composition and mode of nutrition
- 1.4. Plant pathology: symptoms and plant diseases caused by fungi, bacteria and virus
- 1.5. Study of casual organisms, symptoms, etiology and control measures of the following diseases in plants:
 - 1.5.1 Damping off disease
 - 1.5.2 Late blight disease on potato
 - 1.5.3 Rust disease on wheat
 - 1.5.4 Bean mosaic disease

2. Algae and Lichens

- 2.1 Characteristics, classification, reproduction and economic importance of cyanobacteria
- 2.2 Life cycles of *Anabaena* and *Spirulina*.
- 2.2 Algae: characteristics, history of classification (Fritsch), range of vegetative thallus and reproductive structures, Life cycles of Chlorophyceae (*Chlamydomonas* and *Chara*), Rhodophyceae (*Batrachospermum*), Bacillariophyceae (*Naviculla*), Phaeophyceae (*Fucus*) and economic importance of algae
- 2.3 Lichens: characteristics, classification, structure (with anatomy) and reproduction, and economic importance of lichens

3. Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany

- 3.1. Bryophyta: origin, characteristics, classification, range of vegetative and reproductive structures and life cycles of Hepaticopsida (*Riccia*), Anthocerotopsida (*Antheroceros*) and Bryopsida (*Polytrichum*), sterilization of sporogenous tissues in bryophytes, and economic importance of bryophytes
- 3.2. Pteridophyta- origin, characteristics, vegetative and reproductive structures and life cycles in Psilopsida (*Psilotum*), Lycopsida (*Lycopodium* and *Selagenella*), Sphenopsida (*Equisetum*) and Pteropsida (*Pteris* and *Azolla*). Stellar system, heterospory and seed habit, alternation of generations, and economic importance of pteridophytes
- 3.3 Gymnosperms: origin, characteristics, classification, vegetative and reproductive structure and anatomy of Cycadopsida (*Cycas*), Coniferopsida (*Pinus*) and

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Gnetopsida (*Ephedra*), distribution of gymnosperms in Nepal and economic importance of gymnosperms

3.4. Palaeobotany: introduction, general account of geological era and periods with examples, mode of fossil formation, types of fossils, morphology and anatomy of *Rhynia*

4. Angiospermic Taxonomy and Economic Botany

- 4.1. Angiosperms: principle and significance of plant systematics, plant morphology in relation to systematics, botanical terminology
- 4.2. Taxonomic hierarchy and principles of botanical nomenclature
- 4.3. Outline classification systems: artificial (Linneaus), natural (Bentham and Hooker), phylogenetic (Engler and Prantle), modern (Cronquist) and APG system
- 4.4. Distinguishing features, economic importance and phylogeny of Magnoliaceae, Ranunculaceae, Rosaceae, Leguminosae, Asteaceae, Lamiaceae, Orchidaceae, Poaceae and Liliaceae.
- 4.5. Economic botany: distribution and importance of the following economic plants
 - 4.5.1 Cereals: rice (*Oryza sativa*) and maize (*Zea mays*)
 - 4.5.2 Vegetables: potato (Solanum tuberosum) and Asparagus (Asparagus racemosus)
 - 4.5.3 Fruits: apple (*Melos sylvestris*) and mango (*Mengifera indica*)
 - 4.5.4 Oil plants: soyabean (*Glycine max*) and sunflower(*Helianthus annus*)
 - 4.5.5 Fibre plants: cotton (Gossypium hirsutum) and jute (Corchorus capsularis)
 - 4.5.6 Cash crops: tea (Camellia sinensis) and sugarcane (Saccharum officinarum)
 - 4.5.7 Medicinal: *Terminalia chebula*, *Swertia chirata* and *Dactylorhiza hategira*.
 - 4.5.8 Timber: sal (Shorea robusta) and blue pine (Pinus wallichiana)

5. Ecology

- 5.1. Introduction, branches and scope of ecology
- 5.2. Ecosystems: concepts and types, structure and functions of ecosystem, biogeochemical cycles (carbon, water, nitrogen, phosphorus and sulphur cycles)
- 5.3. Community and succession characteristic of community, quantitative and qualitative methods of studying vegetation, succession: general process, causes and types; climax concept of succession
- 5.4. Factors affecting ecosystem: biotic factors and abiotic factors
- 5.5. Environmental pollution: sources, impacts and mitigating measures
- 5.6. Vegetation in Nepal: phytogeography, vegetation types

Section B - 25 Marks

6. Plant Physiology

6.1. Water relations: water potential & chemical potential, absorption of water and its mechanism, diffusion and osmosis, transpiration: definition, types, mechanism of stomatal transpiration, factors affecting transpiration and its significance

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

- 6.2. Mineral nutrition: role of minerals, macro & micro nutrients, concept of absorption and translocation of mineral ions in plants, mineral deficiency and its recovery, fertilizers, hydroponics
- 6.3. Photosynthesis: ultra structure of chloroplast, photosynthetic pigments, radiant energy, light reaction, dark reaction, factors affecting photosynthesis, concept of limiting factors, concept of C_3 and C_4 plants, photorespiration and CAM pathway
- 6.4. Respiration: ultrastructure of mitochondrion, aerobic & anaerobic respiration, glycolysis, krebs cycle, ETS and oxidative phosporylation
- 6.5. Growth and development: definition, concept of plant hormones, discovery and role of auxins, gibberellins, cytokinins, ethylene and ABA. Apical dominance and senescence; tropism; photoperiodism; vernalization; photomorphogenesis; general concept of tissue culture, polarity, seed germination and seed dormancy

7. Cytology Genetics and Plant Breeding

- 7.1. Introduction, structural organization of prokaryotic and eukaryotic cells; concept of endosymbiont theory, structure and functions of chloroplast, mitochondria and nucleus
- 7.2. Nature of chromosomes: physical and chemical nature of chromosomes, structure and functions of nucleic acid, DNA & RNA, mechanism of transcription and translation
- 7.3. Cell cycle: mitosis and meiosis with their significance
- 7.4. Crossing over and chaisma formation: Process and significance
- 7.5. Linkage: types and significance
- 7.6. Chromosomal aberrations; polyploidy and mutation.
- 7.7. Mendel's laws of inheritance
- 7.8. Molecular biology: basic concept of genetic engineering
- 7.9. Nature and scope of plant breeding: methods of crop improvement, selection, hybridization and mutation breeding, breeding for resistance, green revolution and plant breeding for livelihood

8. Developmental Botany and Plant Anatomy

- 8.1. Microsporogenesis and microgametogenesis
- 8.2. Megasporogenesis and megagametogenesis
- 8.3. Pollination, fertilization and endosperm
- 8.4. Embryogenesis in typical dicot and monocot plants
- 8.5. Polyembryony, apospory, apogamy and apomixis
- 8.6. Palynology: introduction, study of pollen morphology as taxonomic evidence
- 8.7. Meristems: structure, classification and theories of differentiation of root and shoot apices
- 8.8. General anatomy of root, stem and leaves; secondary growth and anomalous secondary growth with respect to Bignonia, Aristolochia, Nyctanthes and Dracaena
- 8.9. Ecological anatomy: hydrophytes, mesophytes and xerophytes

9. Plant Biochemistry and Biotechnology

- 9.1. Introduction, scope and importance of biotechnology and its relation with other sciences
- 9.2. Biomolecules: water, carbohydrates, lipids and proteins

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठ्यकम

- 9.3. Enzymes: properties & chemical structure; mechanism of action, denaturation, factors affecting enzyme actions, allosteric protein and feedback, classification and nomenclature
- 9.4. Vitamins: introduction, roles of fat and water soluble vitamins
- 9.5. Plant pigments: structure and function of chlorophylls, carotenoids, anthocyanins and phycobillins
- 9.6. In vitro culture, techniques and principles: methods of plant tissue culture and its applications
- 9.7. Plant microbe interaction: biological nitrogen fixation; symbiotic and asymbiotic organisms for soil fertility and crop improvement; rhizobia, BGA, Frankia and Mycorrhizae
- 9.8. Cryopreservation
- 9.9. Gene transfer in plants: transgenic plants and their importance

10. Environment and Bio-diversity

- 10.1 Environmental issues: population, use and abuse of pesticides, deforestation, urbanization, abuse of chemical fertilizers; environmental consequences of climate change, acid rain, ozone layer depletion, green house effect
- 10.2. Biosphere: structure and composition
- 10.3. Environmental toxicants: types, problems & mitigations.
- 10.4. Energy issues: sustainable energy resources (hydro, wind, solar and bio-fuels)
- 10.5 Natural resource management for sustainable development
- 10.6 Environmental affairs: various national and international environmental organizations and their role in conservation and environmental education
- 10.7. Environmental Impact Assessment: concept, methods with special reference to screening, scoping and TOR.
- 10.8 Biodiversity: overview, biodiversity hotspots centers and biodiversity hotspot in Nepal, causes and consequences of biodiversity loss, species richness in Nepal, values of biodiversity, conservation and management of biodiversity, CITES, endemic, endangered and threatened plant species of Nepal, ecosystem services
- 10.9. Ethnobotany: definition and importance; importance of traditional ecological knowledge
- 10.10. Environmental & biodiversity related policies, Nepal Biodiversity Strategy 2002, Convention on Biological Diversity

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अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

| TT:4 | Tinit | | Weich4 | No. | Specification | | |
|------|---|---------|--------|-------------|-------------------|---------------------------|--|
| No. | Contents Title | Section | - age | of items | I- Level (60%) | II & III - Level (40%) | |
| 1. | Virus, Bacteria and Fungi | | 10 | 10 | 6 | Λ | |
| 2. | Algae and Lichens | | 10 | 10 | 0 | 4 | |
| 3. | Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany | A | 15 | 15 | 9 | | |
| 4. | Angiospermic Taxonomy and Economic Botany | | 15 | 15 | | 6 | |
| 5. | Ecology | | | | | | |
| 6. | Plant Physiology | | | | | | |
| 7. | Cytology Genetics and Plant Breeding | | 15 | 15 | 9 | 6 | |
| 8. | Developmental Botany and Plant Anatomy | В | | \bigwedge | | | |
| 9. | Plant Biochemistry and Biotechnology | | 10 | 10 | 6 | 4 | |
| 10. | Environment and Bio- diversity | | 10 | 10 | 0 | 4 | |
| | Total | | 50 | 50 | 30 | 20 | |

Table of Specification

Paper IV: Optional Paper- Sample MCQs of Botany

I - Level Questions

1. The 'damping off' disease is caused by:

A. Pythium B. Plasmopara C. Phytopthora D. Synchytrium

2. Consanguineous marriages are not advisable because.....

A. More chances of blood abnormalities

- B. More recessive defects are likely to occur
- C. More chances of multiple births

D. More dominant defects are likely to occur

3. Which of the following reaction is true for photosynthesis?

A) $6CO_2+6H_2O \rightarrow C_6H_{12}O_6+6O_2+6H_2O$ C) $6CO_2+6H_2O \rightarrow C_6H_{12}O_6+3O_2+6H_2O$ 4. The statement true for 'generation time' is B) $6CO_2+12H_2O \rightarrow C_6H_{12}O_6+6O_2+6H_2O$ D) $CO_2+H_2O \rightarrow C_6H_{12}O_6+O_2+H_2O$

- A. Time period taken by a cell to become two
- B. Time period between telophase and cytokinesis
- C. Time period between meiosis II and cytokinesis
- D. Time gap between meiosis I and cytokinesis

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

II & III - Level Questions

- 5. Identify the correct statements about Basidiomycetes from the list given below:
 - a. Karyogamy occurs quickly after plasmogamy.
 - b. There is large gap between plasmogamy and karyogamy
 - c. The karyogamy takes place inside the basidium
 - d. The basidiospores formed are diploid.

A) a & b B) b & c C) b & d D) a & d

- 6. Read the following statements and identify the correct and incorrect alternative.
 - 1. Ozone is produced due to burning of fossil fuels
 - 2. Ozone is formed or broken in the presence of UV-rays
 - 3. When the breakdown of ozone exceeds than formation, it leads to depletion.

A. All 1, 2 and 3 are correct.B. All 1, 2 and 3 are incorrect.C. 2 and 3 are correct but 1 is incorrect.D. 1 & 3 are correct but 2 is incorrect.

7. Match the following pairs

- a) Protostele 1. Siphonostele with overlapping leaf gaps
- b) Dictyostele
 c) Sinhapastala
 2. Xylem and phloem form concentric cylinders around the central pith.
 c) Sinhapastala
 d) Another primitive form of stale consists of central rod of yula
- c) Siphonostele
 3. Most primitive form of stele consists of central rod of xylem surrounded by phloem.
 - A. a-1, b-2, c-3B. a-3, b-1, c-2C. a-2, b-1, c-4D. a-2, b-3, c-1

Consider the following diagram/ picture. Answer the following two questions.



8. In the picture drawn the lemma is represented by:

A) a B) b C) c D) d

9. In the picture the perianth is represented by:

A) a B) c C) d D) e

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तुतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

10. Which of the following statements are correct?

- 1. RNA primers produce okazaki fragments
- 2. DNA replication always proceeds in $5' \rightarrow 3'$ direction
- 3. The DNA strand formed in $3^{\circ} \rightarrow 5^{\circ}$ direction is called lagging strand
- 4. Polypeptide chains are directly formed by DNA fragments
- A) All 1, 2, 3 and 4 are correct. B) Only 1, 2 and 3 are correct.
- C) Only 1, 2 and 4 are correct D) Only 2 and 3 are correct

11. Match the following pairs correctly

| a) | Porc | ogam | y | | 1. The embryo sac comes out of the micropyle to receive the pollen tube | | | | | | the | | |
|---|---------------------------------------|---------|----------|---------|---|--------------|-------------|--------|----------|--------|-------------|-----------|--|
| h | Herl | ζοσan | nv | | 2 Pollen tube penetrates through the chalaza | | | | | | | | |
| 0. | Deal | aomi | | | 2. Solf colligation is prevented in bicorreal flowers due to | | | | | | | | |
| c. Basigamy 3. Self pollination is prevented in bisexual flowers du | | | | | | | wers due to | | | | | | |
| | | | | | SO | me barriers | s betv | veen | anther | 's and | stigma. | | |
| d | . Acr | ogam | ıy | | 4. P | ollen tube e | enters | s to e | mbryo | sac t | hrough m | icropyle. | |
| Code | A) | a | b | c | d | | B) | а | b | с | d | | |
| | , | 3 | 4 | 1 | 2 | | , | 1 | 2 | 4 | 3 | h. | |
| | C) | а | b | с | d | | D) | а | b | с | d | | |
| | - / | 2 | 1 | 3 | 4 | | / | 4 | 3 | 2 | 1 | | |
| | | | | | | | | | | | | | |
| 12. Ma | atch t | the lis | st I wit | th list | II | | | | | | | | |
| | Li | ist-I | | | | Lis | t-II | | | | | | |
| a) | Em | ascula | ation | | | 1. Pollin | natio | n doi | ne by n | nollus | scs. | | |
| b) | Ane | emopl | hilly | | | 2. Third | integ | zume | ent | | | | |
| c) | Lev | er me | echani | sm | | 3. Remo | oval d | of an | thers. | | | | |
| d) | Ari | | 4 Salvia | | | | | | | | | | |
| e) | e) Malacophilly 5 Pollination by wind | | | | | | | | | | | | |
| 0) | Iviu | lucop | lilli | | | 5.1011 | iutioi | 109 | wind | | | | |
| А | A) a - | · 2, b | - 4, c · | - 1, d | -5&e | - 4 B |) a - | 3, b | - 5, c - | 4, d · | - 2 & e - 1 | | |
| C | C) a - | 4, b | - 1. c - | - 5, d | -3&e- | - 2 D |) a - | 5. b | - 4, c - | 2, d | -1&e-3 | 5 | |

13. Study the following diagram and identify the correct statements based on the cell cycle:



- 1. G₁-includes the synthesis and organization of substrates and enzymes necessary for DNA synthesis (i e transcription, of r-RNA, m-RNA, t-RNA and synthesis of protein).
- 2. S-phase indicates chromosome as well as DNA replication
- 3. G₂- phase indicates the growth of cytoplasm and constituent cell organelles
- 4. M- phase indicates the multiplication of cellular components
- 5. G_1+S+G_2 collectively constitute the interphase.
- A) 1, 2, 3 and 4 are correct.
- B) 1, 2, 3 and 5 are correct.
- C) 2, 3, 4 and 5 are correct.
- D), 3, 4 and 5 are correct.

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Paper IV: Optional Paper (006) - Engineering

Section A - 25 Marks

1. Engineering Mathematics

1.1. Function, Derivative, Differential and Integral

- 1.1.1. Function: basic, algebraic and elementary function
- 1.1.2. Velocity of Motion, geometric meaning of derivative; derivative of Logarithmic function and meaning of second derivative
- 1.1.3. Maxima and Minima of functions, application of theory of maxima and minima of functions for solution of engineering problems
- 1.1.4. Lagrange's and Newton's interpolation formula, limit and derivative of a vector function in a scalar argument and first and second derivatives of a vector with respect to arc length
- 1.1.5. Area computation in rectangular and polar coordinates arc length of a curve, volume and area of a solid sphere, semi sphere and cylinder

1.2. Transforms and series

1.2.1. Laplace transform and its application for solution of differential equation

1.2.2. Fourier series, Periodic function, even and odd function

1.3. Theory of probability Mathematical statistics and matrices

- 1.3.1. Probability of an event, Probability of independent events, conditional probability, and distribution law of discrete random variables
- 1.3.2. variance, standard deviation, moments, function of random variables and law of uniform distribution, Normal distribution , its types and probable error
- 1.3.3. Problems of mathematical statistics, statistical data, statistical series histogram and regression analysis
- 1.3.4. Transforming a vector into another vector, solving system of linear equation by matrix method and differentiation and integration of matrices

2. Electrical Engineering

- 2.1. Electrical Engineering Materials: Conducting, insulating & semiconductor materials
- 2.2. **Circuit Parameters:** resistance, inductance, capacitance and temperature effect of resistance
- 2.3. **Circuit Fundamentals:** Series & parallel circuits, circuit elements, independent & dependent sources, Ohm's law, Kirchhoff's Voltage & current laws
- 2.4. **Network Theorems:** Mesh's and Nodal's analysis of electrical circuits, Thevenin's, Norton's, maximum power & reciprocity theorems
- 2.5. **AC circuits:** Concept of complex impedance, phaser diagram, Active, Reactive & Apparent power, Power factor, resonance in AC circuit
- 2.6. **Three Phase Circuits:** Phase & Line voltages & currents in three phase system, 3-phase power
- 2.7. Semi-conductor devices: Diodes, Transistors, BJT, MOSFET, thyristors

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Section B - 25 Marks

3. Component Engineering Drawing

- 3.1. **Drawing Skills:** skill in drafting lines, Geo-metrical drawings, scales and dimensions, ratio, symbols and drafting tools
- 3.2. Interpretation of geometrical forms: prismatic and parametric
- 3.3. Principles of composition and elements of composition
- 3.4. Orthographic projection, isometric views, perspective views one point perspective and two point perspective
- 3.5. Applied geometry and geometrical construction
- 3.6. Descriptive geometry
- 3.7. Theory of projection
- 3.8. Sectional views
- 3.9. Auxiliary views
- 3.10. Development and intersections
- 3.11. Machine drawings
- 3.12. Electrical Symbols

4. Applied Mechanics

- 4.1. Statics of Particles and Rigid Bodies
 - 4.1.1. Concept of Particle and Rigid Body
 - 4.1.2. Principles of Force
 - 4.1.3. Free Body Diagrams
 - 4.1.4. Equilibrium in 2-D and 3-D
- 4.2. Forces on Particles and Rigid Bodies
 - 4.2.1. Characteristics and type of Forces
 - 4.2.2. Transmissibility and Equivalent Forces
 - 4.2.3. Resolution and Composition
 - 4.2.4. Movement of Force About a point and an axis
 - 4.2.5. Resolution of a Force into a Force and a Couple
 - 4.2.6. Resultant of a System of Forces
- 4.3. Distributed forces
 - 4.3.1. Centers of Gravity
 - 4.3.2. Centroids of Lines, Areas and Volumes
 - 4.3.3. Second Moment of Area and Moment of Inertia
- 4.4. Analysis of Structures: Beams, Trusses and Frames
 - 4.4.1. Types of Frames, Statically Determinate or Indeterminate
 - 4.4.2. Classification of Loads and Supports
 - 4.4.3. Determination of internal Forces in Beams, Trusses and Frames
 - 4.4.4. Shearing Force, Bending Moment and Axial Force Diagrams
- 4.5. Friction
 - 4.5.1. Laws of friction
 - 4.5.2. Static friction

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Table of Specification

| Unit | | | Weight | No of | Specification | | |
|------|-------------------------------|---|--------|-------|-------------------|---------------------------|--|
| No. | No. Contents Title | | -age | items | I -Level (60%) | II & III - Level (40%) | |
| 1. | Engineering Mathematics | ٨ | 12 | 12 | 7 | 5 | |
| 2. | Electrical Engineering | A | 13 | 13 | 8 | 5 | |
| 3. | Component Engineering Drawing | п | 12 | 12 | 7 | 5 | |
| 4. | Applied Mechanics | В | 13 | 13 | 8 | 5 | |
| | Total | | 50 | 50 | 30 | 20 | |

Paper IV: Optional Paper- Sample MCQs of Engineering

I-Level Questions

1. If $f(x) = x^2$ is expanded as Fourier series in the interval (-a, a) then Fourier coefficient a_0 is equal to

C) 10

A)
$$\frac{a^2}{2}$$
 B) $\frac{a^3}{3}$ C) a^2

2. Minimum value of |2x-10| is at x equal to

A) 2 B) 5

D) 0

- 3. Norton's equivalent of a circuit consists of
 - A) ideal voltage source and a parallel resistor
 - B) ideal current source and a parallel resistor
 - C) ideal voltage source and a series resistor
 - D) ideal current source and a series resistor
- 4. The following components are all active components
 - A) a resistor and an inductor
 - B) an Opamp, a BJT and thermionic triode
 - C) a capacitor, and an inductor
 - D) a diode, a BJT and an FET
- 5. The light tone is done by.....Grade pencil.
 - A) H, 2H, 3H B) HB, F C) B, 2B, 3B D) H, HB, F

6. The total dimensioning methods given in a drawing of certain objects are

- A) Element to Element
- B) Centre to Centre
- C) overall dimension
- D) internal room

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7. The moment of inertia of a triangular section (base b, height h) about centroidal axis parallel to the base is

A)
$$\frac{hb^3}{12}$$

B) $\frac{bh^3}{3}$
C) $\frac{bh^3}{36}$
D) $\frac{bh^3}{2}$

II & III - Level Questions

8. The area of the region bounded by the lines y = x, y = 0 and x = 2, is A) 8 B) 2 C) 6 D) 4

9. If
$$f(x) = \log_e(\log_e x)$$
, then $\frac{d}{dx}f(x)$ is equal to

A)
$$\frac{1}{\log_e x}$$
 B) $\frac{1}{\log_e(\log_e x)}$ C) $\frac{1}{x\log_e x}$ D) $\frac{x}{\log_e x}$

- 10. Value of current at resonance in a series RLC circuit is affected by the value of
 - A) L B) R C) C D) L & C
- 11. The power taken by a 3-phase load is given by the expression
 - A) $3 V_L I_L Cos \Phi$
 - B) $\sqrt{3} V_L I_L Cos \Phi$
 - C) $\sqrt{3} V_{ph}I_{ph} Cos\Phi$
 - D) $3 V_{ph}I_{ph}Sin\Phi$
- 12. The front view of following object is



- 13. In FAR, which of the following area is not included?
 - A) basement parking area
 - B) first floor area
 - C) ground floor area
 - D) third floor area

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14. The resolved part of the resultant of two forces inclined at angle θ in the given direction is

- A) Algebraic sum of the resolved parts of the forces in the direction
- B) Arithmetical sum of the resolved parts of the forces in the direction
- C) Sum of the forces multiplied by the $\sin \theta$
- D) Sum of the forces multiplied by the tangent θ
- 15. Force of friction depends on
 - A) Contact area only
 - B) Force and contact area
 - C) Force and roughness
 - D) Force, roughness and contact area

16. Inverse Laplace transform of the function $F(s) = \frac{s-a}{(s-a)^2 + b^2}$ is

A) $e^{bt} \sin at$ B) $e^{bt} \cos at$ C) $e^{at} \sin bt$ D) $e^{at} \cos bt$

17. Two cards are drawn at random from a pack of 52 cards. The probability of getting at least a spade and an ace is

| . 1 | B) 8 | \sim 1 | \mathbf{D} 2 |
|-------------------|--------------------|----------------|----------------|
| A) $\frac{1}{34}$ | B) $\frac{1}{221}$ | $\frac{C}{26}$ | $\frac{D}{51}$ |

- 18. When n numbers resistances of each value r are connected in parallel, then the resultant resistance is x. When these n resistances are connected in series, total resistance is
 - A) n^2x
 - B) nx
 - C) x/n
 - D) rnx

19. Which of the following bulbs will have the least resistance?

A) 220 V, 60 W B) 220 V, 100 W C) 115 V, 60 W D) 115 V, 100 W

20. The center of gravity of a 10*15*5 cm T section from its bottom is

A) 7.5 cm B) 5.0 cm C) 8.75 cm D) 7.85 cm

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

Paper IV: Optional Paper (007) Environmental Science

Section A - 25 Marks

1. Basics of Environmental Science & Ecology

- 1.1 Introduction, elements and scope of environment; Concepts on atmosphere, hydrosphere, lithosphere and biosphere; Environmental Education; historical background and philosophy.
- 1.2 Concept, history and scope of Ecology; Concept, types and components of ecosystems; Energy flow in an ecosystem; Primary and secondary production ; Determining productivity in ecosystems; Food chain and food web; Ecological pyramids, Ecological indicators; Gaseous and sedimentary cycles.
- 1.3 Population and community characteristics, Population growth; Species interaction, Community succession, Heterogeneity and equitability;, Ecological niche; Ecological dominance; Ecotone and edge effect.
- 1.4 Classification, distribution and growth of microorganisms; Microbial interaction and symbiotic relationship; Microorganisms and human health; Waterborne diseases, Role of microorganisms in solid waste and wastewater treatment; Bioremediation.
- 1.5 Lentic and lotic environment; Importance of freshwater environment; Morphometry of freshwater bodies; Freshwater communities; Biological water quality parameters; Ecosystem services of aquatic ecosystems; Concept of water footprint.
- 1.6 Sustainable management of ecosystems; Biological conservation; *ex-situ* and *in-situ*; Conservation approaches at species, ecosystem and landscape level

2. Environmental Earth Science

- 2.1 Earth Science: Earth as a closed system; Internal structure of earth; Geological agents of change; Rocks and minerals; rock classification and rock mass rating; Formation of landscapes and landforms; Land use pattern; Weathering and erosion; Physiographic regions of Nepal.
- 2.2 Soil Science: Process and factors affecting soil formation; Soil profile and its development; Chemical and mineralogical composition of soil; Humus; nature, properties and formation; Soil reactions; Soil types of Nepal

3. Hydrometeorology and Environmental Issues

- 3.1 Meteorology and Hydrology; Meteorological fundamentals: pressure, temperature, wind, humidity, solar radiation; Atmospheric stability; Adiabatic; Turbulence an diffusion; Applications of meteorological principles to transport and diffusion of pollutants; Scavenging process; Wind roses, Seasons of Nepal; Hydrological cycle; Precipitation forms and interpretation of precipitation data.
- 3.2 Global Environmental Issues: Climate change; Acid rain; Ozone layer depletion; Biodiversity depletion, Urbanization and globalization; Environmental refugees

4. Environmental Chemistry and Biostatistics

4.1 Environmental Chemistry: Volumetric, gravimetric and spectrophotometric analysis; Potentiometric and conductometric titrations; Basic principles of instrumentation; Reactions in air, water and soil.

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4.2 Bio-statistics: Environmental statistics: sources, nature and needs; Population and samples; Sampling types and sample size determination, Fundamental statistical measures; Probability and its basic concept; Hypothesis testing and inferences drawing.

5. Environmental Pollution and Mitigation Technique

- 5.1 Air Pollution: Structure and composition of atmosphere; Outdoor and indoor air pollution; Photochemical and industrial smog; Effects of air pollution on human health, animals, plants, materials and atmospheric properties; Transboundary air pollution; Air quality monitoring; Air pollution prevention and control; National air quality standards and legislations;
- 5.2 Water Pollution: Sources and categories of water pollution; Physico-chemical parameters of water pollution; Oxygen sag curve; Water quality criteria and drinking water quality standards; Methods of water analysis; Water and wastewater treatment methods; National water pollution control legislations.
- 5.3 Noise Pollution: Sources and impacts of noise; Measurement of sound; National legal frameworks for noise pollution control.
- 5.4 Soil Pollution: Sources of soil pollution; Agrochemicals and soil quality; Environment and human health effects of pesticides; Soil loss and its estimation; Biological control of pests; integrated pest management (IPM); Reclamation of degraded soil, Soil conservation techniques.

Section B - 25 Marks

6. Waste management, Environment Toxicology and Radiation

- 6.1 Solid Waste Management: Sources and types of solid waste; Nature and composition of solid waste; Categories and selection of landfill sites; Integrated solid waste management; Hazardous wastes: sources and disposal/management options; UNEP guideline for disposal of hazardous wastes; Agricultural and Industrial waste management.
- 6.2 Environmental Toxicology: Types of toxicants; Fate of toxicants in living systems; Acute and chronic toxicity; Forensic toxicology; Biotransformation of toxicants; Pesticides and problems associated with its use; Response to doses of toxicants; Cumulative toxicity; Mechanism to minimize toxic effects; Bio-magnification, bioconcentration and bioaccumulation.
- 6.3 Radiation and Environment: Types of Radiation; Radioactivity; Radiation dose; Effects of ionizing radiation; Nuclear fission in nuclear power plants; Residual radiation; Radioactive waste management and treatment; General methods of determining radioactivity.

7. Environment Assessment and Hazards

- 7.1 Environment Assessment: History of Environmental assessments; IEE,EIA, SEA; Environmental screening, Scoping; Terms of Reference (TOR); Baseline information collection; Alternative analysis; Identification, prediction and evaluation of environmental impacts; Environmental protection measures (EPM); IEE and EIA approval process in Nepal. Relevant acts, policies and guidelines related to EAs.
- 7.2 Environmental Hazards: Natural hazard, danger and risk; Hazard classification; Natural hazards: earthquake, volcano, landslides, flood, debris flow, avalanches, GLOFs; Tools and techniques of hazard assessment.

8. Living and Biological Resources

- 8.1 Biological Resources: Biological resources and biodiversity; Biodiversity of Nepal; Benefits of biological resources; Threats to biological resources; Management of biological resources; Status and opportunities of biodiversity conservation in Nepal.
- 8.2 Water Resources: Major water reserves of globe; Nepal's richness in water resources; Use of water resources; Renewable and new sources of water; Multipurpose scheme for water resource development; Sustainable management of water; Concept of watershed management.
- 8.3 Food Resources: Major food resources; New food resources; World food problems; Nutrition and human health problem; Agricultural policy of developed and developing countries; Agriculture and food policies of Nepal.

9. Natural Resources

- 9.1 Energy Resources: Perpetual, renewable and non-renewable energy resources; consequences of energy consumption; Energy economics and policy; Energy and national development.
- 9.2 Mountain Resources; Altitudinal features of the earth; Mountain specificities; Initiatives for sustainable management of mountain resources; Tourism and ecotourism in mountains; Environmental concern and sustainable development of mountains.
- 9.3 Mineral Resources: Metallic and non metallic mineral resources. Mineral resources of Nepal.

10. Human Resource, Economics & Legislations

- 10.1Human Resources: Demography; Human population and projections; Environmental and socio-economic factors responsible for fertility, mortality and migration; Population distribution and growth trend in Nepal.
- 10.2Environment and Resource Economics: Economics and environmental economics; Economic growth and development; Limits of economic growth; Nexus between economic growth and pollution; Externalities; Green accounting; Economic valuation of ecosystem services; Payment of ecosystem services.
- 10.3Environmental Policy and Legislations: Environmental policies of Nepal; International treaties and conventions; National legislations on environmental conservation; Institutional arrangement for environmental conservation in Nepal.

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खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

Table of Specification

| Unit | | | Woight | No. of | Specification | | |
|------|--|---------|--------|--------|-------------------|---------------------------|--|
| No. | Contents Title | Section | age | items | I -Level (60%) | II & III - Level (40%) | |
| 1. | Basics of Environmental Science and | | | | | | |
| | Ecology | | | 15 | 9 | | |
| 2. | Environmental Earth Science | | 15 | | | 6 | |
| 3 | Hydrometeorology and Environmental | | | | | | |
| 5. | Issues | Α | | | | | |
| 4 | Environmental Chemistry and | | 10 | 10 | 6 | 4 | |
| 4. | Biostatistics | | | | | | |
| 5 | Environmental Pollution and Mitigation | | 10 | | | | |
| 5. | Technique | | | | | | |
| 6 | Waste management, Environment | | | | | | |
| 0. | Toxicology and Radiation | | 10 | 10 | 6 | 4 | |
| 7. | Environment Assessment and Hazards | | | | | | |
| 8. | Living and Biological Resources | В | | | | | |
| 9. | Natural Resources | | 15 | 15 | 0 | 6 | |
| 10 | Human Resource, Economics & | | 15 | 15 | 9 | 0 | |
| 10. | Legislations | | | | | | |
| | Total | | 50 | 50 | 30 | 20 | |

Paper IV: Optional Paper- Sample MCQs of Environmental Science

I - Level Questions

- 1. Which of the following greenhouse gases has the greatest heat trapping ability per molecule?
 - A) Carbon dioxide B) Chlorofluorocarbon
 - C) Methane D) Nitrous oxide
- 2. The WHO guideline value for iron in drinking water is
 A) 0.01 mg/L
 B) 0.3 mg/L
 C) 0.001 mg/L
 D) 0.005 mg/L
- 3. Toxicity rating is ------, when the LD50 (milligrams per kilogram of body weight) is less than 0.01.
 - A) Essentially nontoxic B) Slightly toxic C) Toxic D) Supertoxic
- 4. Read the given two statements and state true or false
 - 1. The chemical composition of CFC-12 is CF_2Cl_2
 - 2. The chemical composition of chloroform is CFCl₃
 - A) 1 is true, but 2 is false
 - B) 1 is false, but 2 is true
 - C) Both the statements are correct
 - D) Both statements are incorrect
- 5. Match the followings:
 - i. Mayfly nymph a. Periphyton
 - ii. Azolla b. Macrophyte
 - c. Macroinvertebrate

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A) i - c, ii - b B) i - b, ii - c C) i - a, ii - c D) i - a, ii - b
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II & III - Level Questions

- 6. Which one of the following animals belongs to appendix I of CITES list:
 - a. Platanista gangetica
 - b. Taxus wallichiana
 - c. Cervus duvaucelii
 - d. Axis axis
 - A) a and c
 - B) a and b
 - C) a and d
 - D) b and c
- 7. The following events are related to major case studies of environmental pollution. Place the events in chronological order
 - 1. Bhopal, India
 - 2. Exxon Valdez
 - 3. Donora Pennsylvania
 - 4. Three Mile Island
 - 5. Chernobyl Ukraine
 - A) 1-2-3-4-5
 - B) 5 4 3 2 1
 - C) 1-3-5-2-4
 - D) 1 5 2 4 3
- 8. Read the following statements and identify the correct and incorrect alternative
 - 1. Beta diversity refers to degree in which species composition changes along an environmental gradient
 - 2. Alpha diversity refers for the number of species in a single community
 - 3. Diversity is reciprocal of dominance
 - A) All a, b and c are correct
 - B) All a, b and c are incorrect
 - C) a and c are correct but b is incorrect
 - D) a and b are correct but c is incorrect
- 9. Match the followings:
 - i. Mayfly nymph
 - ii. Azolla
 - iii. Volvox

- a. Periphyton
- b. Macrophyte
- c. Phytoplankton
- d. Macroinvertebrate

Code:

- A) i-c, ii-b, iii a
- B) i-d, ii-b, iii-c
- C) i-a, ii-c, iii d
- D) i-a, ii-b, iii-c

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- 10. Read the following statements and identify the correct and incorrect alternative
 - 1. Proto-cooperation is the non-obligatory association
 - 2. Proto-cooperation is the obligatory association
 - 3. Mutualism is the obligatory association
 - 4. Mutualism is both obligatory and non-obligatory association
 - A) All 1, 2, 3 and 4 are correct
 - B) 1 and 3 are correct but 2 and 4 are incorrect
 - C) 1, 2 and 3 are correct but 4 is incorrect
 - D) 2 and 4 are correct but 1 and 3 is incorrect
- 11. Match the followings:
 - i. Stonefly nymph a. Periphyton
 - ii. Eichhornia
 - iii. Diatom
- b. Macrophyte c. Phytoplankton
- iv. Brachionus
- d. Zooplankton e. Macroinvertebrate
- A) i-d, ii-b, iii-c, iv a
- B) i-d, ii-b, iii-c, iv e
- C) i-e, ii-b, iii-c, iv d
- D) i-a, ii-b, iii-c, iv d

12. Compare and contrast the information given in first column and second column

- I. CITES
- II. Agenda 21

- a. Climate Changeb. Sustainable development
- 0.5
- III. CBD IV. Kyoto

- c. Conservation of biodiversity
- d. Endangered flora and fauna
- A) I d, II b, III c and IV a
- B) I a, II b, III c and IV d
- C) I b, II d, III c and IV a
- D) I d, II b, III c and IV a
- 13. Reasons that the population size of an exotic species grows rapidly when the species is introduced in a new environment include which of the following?

I. The exotic species is resistant to pesticides.

- II. There is a large, underutilized food source in the new environment.
- III. The exotic species has few natural predators in the new environment.
- A) I only
- B) II only
- C) I and III only
- D) II and III only

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Paper IV: Optional Paper (008) – Forestry <u>Section A - 30 Marks</u>

1. Silviculture and Mensuration

- 1.1. Silviculture and its role in Renewable Natural Resource Management
- 1.2. Development of Silviculture systems and methods of Reproduction
- 1.3. Methods and application of different thinning, tending and improvement and salvage operations in forest management
- 1.4. Silvicultural practices adopted for different forest management systems in Nepal
- 1.5. Seed collection, handling, storage and certification
- 1.6. Principles and practices of natural and artificial regeneration, various techniques of plant propagation, plantation techniques, plantation establishment, tending operations and forest rotations
- 1.7. Principles and application of tree improvement
- 1.8. Silvics of commercially valuable trees of Nepal
- 1.9. Principles and practices of tree and forest measurement; different methods of forest sampling and inventory, volume calculation of standing trees, logs and converted timber; measurement of trees and determination of tree and stand volume
- 1.10. Estimation of trees and stand growth, and yield

2. Forest Management

- 2.1. Principles of Sustainable Forest Management (SFM); criteria and indicators of SFM, forest certification schemes and their importance for SFM
- 2.2. Principles and practices of management of natural and plantation forests
- 2.3. Forest stock regulation, growing stock estimation, increment calculation, crop rotation, allowable cut estimation and other methods of yield regulation
- 2.4. Concepts and methods of timber stand improvement, shrubland and rangeland management
- 2.5. Protection of forests from encroachment, abiotic and other biotic factors including animals, disease and pest
- 2.6. Preparation and implementation of Forest Management/Operational Plan, management decisions, and monitoring and evaluation
- 2.7. Principles and methods of community based forest and natural resource management systems in Nepal
- 2.8. Community Forest Management processes and its role in sustainable forest management and rural development
- 2.9. Role of Community Forest/Leasehold Forest/Collaborative Forest in rural livelihood improvement and their issues and challenges
- 2.10. Agroforestry systems and practices in Nepal

3. Forest Resource Assessment and Forestry Research

- 3.1. Forest Statistics and Forest Resource Assessment Practices
- 3.2. Basic steps involved in forest research; research design; methods of data collection, analysis and interpretation
- 3.3. Application of experimental designs in forest research with different parametric and non-parametric tests
- 3.4. Progeny and provenance trial

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- 3.5. Principles and methods of forest sampling sample size, sampling intensity, sampling unit, simple random sampling, stratified random sampling, systematic sampling
- 3.6. Principles of forest biometrics, trees and forest growth models, tree volume and yield tables
- 3.7. Principles, tools and techniques used in Remote Sensing, GIS and Aerial Photo interpretation
- 3.8. Use of Surveying and mapping instruments, and preparation of forest maps
- 3.9. Application of GIS for Planning and decision making in natural resource management
- 3.10. Forest extension and communication

4. Soil Conservation and Watershed Management

- 4.1. Soil formation, soil profile, physical and chemical properties of soil and soil classification
- 4.2. Land use and land capability classification
- 4.3. Concept of hydrological cycle
- 4.4. Types of soil erosions and erosion processes
- 4.5. Soil and water conservation measures breast walls, retention wall, check dams, ponds, slope stabilization, methods of top soil cover, roadside stabilization,
- 4.6. Bioengineering, soil fertility and indigenous soil fertility management practices in Nepal
- 4.7. Concept and approaches of integrated watershed management
- 4.8. Identification, planning and management of micro and macro watershed areas
- 4.9. Concept and approaches to water harvesting and conservation farming
- 4.10. Participatory approaches to soil conservation and watershed management

5. Planning and management of National Parks and Protected Areas

- 5.1. Concepts and approaches of Protected Area (PA) management systems
- 5.2. Status of Protected Areas in Nepal (National Park, Conservation Area, Hunting Reserves, Wildlife Reserve, Buffer Zone etc.)
- 5.3. Preparation and implementation of management plans for different types of Protected Areas
- 5.4. Sustainable development of eco-tourism and visitor management
- 5.5. Conflict resolution and monitoring of Protected Areas management and wildlife census
- 5.6. Conservation education motivation, communication, exhibition and public relations
- 5.7. Fundamentals of forest ecosystems, approach and population ecology (population density, carrying capacity, predation, reintroduction and relocation)
- 5.8. Wetlands and their management
- 5.9. Wildlife farming, breeding and marketing
- 5.10. Wildlife assessment methods

6. Biodiversity conservation

- 6.1. Role and scope of PAs and Buffer Zone in biodiversity conservation
- 6.2. Approaches to biodiversity conservation, Ecosystem management *in-situ* and *ex-situ* conservation, and conservation of biodiversity at ecosystem, species and genetic level

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- 6.3. Geographical distribution, habitat and behavior of common and endangered Nepalese mammals, birds, reptiles, insects and fish
- 6.4. Types of wildlife habitats, habitat analysis and conservation, and management techniques
- 6.5. General understanding about IUCN red list, Biodiversity strategy for PAs, Environmental Impact Assessment (including IEE)
- 6.6. Geographical distribution, status, population and threats to various plants of economic importance (MAPS and trees)
- 6.7. Strategy and Action Plans for the management of rare, endangered and threatened flora and fauna of Nepal (including Tiger, Rhino, Elephant, Snow leopard, etc...)
- 6.8. Conservation and sustainable use of Nepalese flora and fauna, efforts of biodiversity conservation in Nepal

Section B - 20 Marks

7. Forest Utilization

- 7.1. Economically important non-timber forest products of Nepal
- 7.2. Forest based industries and their functioning in Nepal
- 7.3. Conservation, collection, processing and marketing of high value NTFPs in Nepal
- 7.4. Different methods of conversion, processing, treatment of wood/timber and value addition
- 7.5. Scope and role of different forest products in poverty reduction in Nepal
- 7.6. Forest roads and other means of transportation and their management in enhancing forest product promotion and marketing
- 7.7. Community based forest enterprises development
- 7.8. Forest product value chain development

8. Forest Resource Economics

- 8.1. Concept and Scope of Forest resource economics
- 8.2. Basic Economic System of Nepal
- 8.3. Different methods and practices of measuring GNP and GDP
- 8.4. Forest sector's contribution to GDP in Nepal and its limitations and future prospects
- 8.5. Different tools and methods of estimating marketable and non marketable forestry produced goods and services
- 8.6. Demand and supply situation of forestry products of Nepal
- 8.7. Project cycle, planning, monitoring and evaluation
- 8.8. Risk and uncertainty in forest sector investment.

9. Forest Ecology and Ecosystem Services

- 9.1. Forest, vegetation and ecosystem types of Nepal
- 9.2. Concept of locality factors and their effect on growth and yield of forest
- 9.3. Role of Ecology in the management of renewable natural resources
- 9.4. Ecosystem services and their valuation methods
- 9.5. Concept and mechanism of payment of environmental services
- 9.6. Environment assessment and monitoring tools and techniques: Initial Environment Examination and Environmental Impact Assessment
- 9.7. Climate change, its effects, and mitigation and adaptation measures
- 9.8. REDD⁺ and Carbon Trade

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10. Forestry Sector Policy, Strategy, Acts, Rules and Regulations

- 10.1. Forest Act, 2049
- 10.2. Forest Regulation, 2051
- 10.3. Buffer Zone Management Regulations, 2052
- 10.4. Environment Protection Act, 2053,
- 10.5. Environment Protection Regulations, 2054
- 10.6. Private Forest Nationalization Act, 2013
- 10.7. Soil and Water Conservation Act, 2039
- 10.8. Forestry Sector Master Plan, 1988
- 10.9. Current Five Year Development Plan
- 10.10. National Parks and Wildlife Conservation Act, 2029
- 10.11. National Parks and Wildlife Conservation Regulation, 2030
- 10.12. National Biodiversity Strategy, 2002 AD
- 10.13. Medicinal Plants and NTFP Policy, 2061 (Jadibuti tatha gairakastha banpaidawar Niti 2061)
- 10.14. Convention on Biological Diversity, 1992 AD
- 10.15. Wildlife farming, breeding and research policy, 2060
- 10.16. Domesticated Elephant Management Policy, 2060
- 10.17. Procedure for the preparation of Biodiversity Documents, 2060
- 10.18. Guidelines for the preparation of Terms of Reference and Final report of the Initial Environmental Examination (IEE) 2061
- 10.19. Convention on International Trade in Endangered Species of Wild Fauna and Flora, 1975 AD
- 10.20. Wetland Policy, 2060
- 10.21. Nepal Water Policy, 2004

Specification Unit Weight No. of **Contents Title** Section I - Level II & III - Level No. -age items (60%) (40%)Silviculture and Mensuration 1. 2. Forest Management 9 15 15 6 Forest Resource Assessment 3. and Forestry Research Soil Conservation and 4. A Watershed Management Planning and management of 15 15 9 6 National Parks and Protected 5. Areas **Biodiversity conservation** 6. 7. Forest Utilisation 10 10 6 4 Forest Resource Economics 8. Forest Ecology and 9. **Ecosystem Services** B Forestry Sector Policy, 10 10 6 4 Strategy, Acts, Rules and 10. Regulations Total 50 50 30 20

Table of specification

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

Paper IV: Optional Paper- Sample MCQs of Forestry

I - Level Questions

- 1. The type of thinning in which dominant trees are removed in order to stimulate the growth of the trees of the lower crown classes is called;
 - A) Low thinning
 - B) Crown thinning
 - C) Selection thinning
 - D) Mechanical thinning
- 2. According to prevailing law, at least how much money earned by Community Forest User Group should be spent in forest development work?
 - A) 25% B) 30% C) 35% D) 50%
- Which alphabet among the following soil horizons denotes soil parent material?
 A) o
 B) c
 C) a
 D) p
- 4. Which of the following habitat provides the most concentration and diversity of wildlife?
 - A) Dense forest
 - B) Sparse forest
 - C) Ecotone
 - D) Grassland
- 5. On the basis of biodiversity, the world is divided into categories.
 - A) 12
 - B) 15
 - C) 11
 - D) 6

II & III -Level Questions

- 6. Consider the following two statements:
 - 1. On slopping ground, the diameter at breast height should be measured from uphill side
 - 2. The caliper and tapes both are checked for their accuracy before diameter measurement with Fommes caliper.

Which of the statements given above is/are correct A) 1 only B) 2 only

C) Both 1 & 2 D) Neither 1 nor 2

7. Distinguish true or false.

Chir Pine tree is:

- a. Strong light demander
- b. Fire resistant
- c. Shade tolerant
- d. Hard wood
- A) a and b are correct
- B) b and c are correct
- C) a and c are correct
- D) a and d are correct

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- 8. Why Ecological footprint should be considered?
 - a. For conservation and management of protected areas because several tourists visit parks and reserves
 - b. For the conservation of flagship species
 - c. For determining the support capacity of any site of the earth
 - A) b and c are correct, but a is incorrect
 - B) a and c are correct, but b is incorrect
 - C) All a, b, and c are correct
 - D) All a,b, and c are incorrect
- 9. There are eight land capability classes in land capability classification of the United States whereas in Nepal lands are grouped into classes and sub-classes.
 - A) 10 and 5
 - B) 8 and 4
 - C) 7 and 5
 - D) 6 and 4
- 10. Which one of the following statement has greater probability of its inclusion in forest sampling if larger units have greater probability.
 - A) Selection with replacement
 - B) Selection with probability proportion to sample.
 - C) Selection with constant probability
 - D) Selection without replacement
- 11. Which one of the following classes represents land capability classification IV?
 - A) Soils having few limitations that restrict their use
 - B) Soils having limitations that prevent their use for commercial plant production
 - C) Soils having severe limitations that make them unsuitable for cultivation
 - D) Soils having severe limitations that restrict the choice of plants
- 12. As per the prevailing Forest Act, forest is generally opened for 8 months in a year for the purpose of collecting timber and firewood. But in which case forest is opened for collecting timber and firewood all over year?
 - a. For religious purpose
 - b. For development works
 - c. For cremation of dead body
 - d. For agriculture implements
 - A) a and b are correct, but c and d are incorrect
 - B) b and c are correct, but a and d are incorrect
 - C) a and c are correct, but b and d are incorrect
 - D) c and d are correct, but a and b are incorrect

2. Non-timber forest product

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

13. Match the following:

- a. Community forest 1. Protected mammal
- b. Ghadiyal
- c. Kutki
- d. Arna
- 3. National forest
 4. Protected reptile
- A) a 1, b 2, c 3, d 4
- B) a 2, b 3, c 4, d 1
- C) a 3, b 4, c 2, d 1
- D) a 4, b 1, c 2, d 2

14. Match the following:

- a. Manning
- b. Von Mantel
- c. MacArthur and Wilson
- d. Boehm

- 1. Yield regulation
- 2. Calculate velocity of flow
- 3. Capillarity theory
- 4. Island Biogeography theory
- Code b d a <u>c</u> 2 A) 1 3 1 B) 2 3 4 1 2 1 4 3 C) 3 2 4 1 D)

15. Match the following:

Basis of yield regulation Methods

- a. Volume 1. Hufnagl's method
- b. Volume and Increment 2. Von Mantel's method
- c. Area and Volume 3. Cotta's method

| A) | a-1-i, | b-2-ii, | c-3-iii |
|----|----------|----------|---------|
| B) | a-2-iii, | b-1-ii, | c-3-i |
| C) | a-3-i, | b-2-iii, | c-1-ii |
| D) | a-2-ii, | b-3-I, | c-2-i |

$$\label{eq:result} \begin{split} & \underline{Formula} \\ & i. \ Y_a = (V + P_i/2)/P \\ & ii. \ Y_a = \ [V + (a*i*r/4)]/(r/2) \end{split}$$

iii. $Y_a = 2GS/r$

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

Paper IV: Optional Paper (009) – Health Science <u>Section A - 30 Marks</u>

1. Human Anatomy

- 1.1. General principles and basic structural concept of gross anatomy of skin, fascia, muscles, joints, heart, stomach, intestines, liver and gallbladder, lungs, spleen, kidneys, uterus, ovary, testes, pituitary, thyroid, parathyroid and adrenal glands
- 1.2. Histological features of skin, skeletal muscles, smooth muscle and heart, parotid gland, bronchi, testis, skin, bone and thyroid gland
- 1.3. Gross anatomy of nervous system: subdivisions and their functions, neurons, nerve fibres and synapses
- 1.4. Embryology of vertebral column, respiratory system and their congenital anomalies

2. Human Physiology and Biochemistry

- 2.1. Neurophysiology: Sensory receptors, reticular formation, cerebellum and basal ganglia
- 2.2. Reproduction: Regulation of functions of male and female gonads
- 2.3. Cardiovascular system: Mechanical and electrical properties of heart including ECG : regulation of cardio-vascular functions
- 2.4. Gistro Intustim System: bilirubin metabolism, liver function tests (digestion and absorption of fats, metabolism of carbohydrates)
- 2.5. Haematology: haemogolobin synthesis, abnormal hemoglobins
- 2.6. Respiration: regulation of respiration
- 2.7. Renal Physiology: tubular function, regulation of pH
- 2.8. Nucleic acids: RNA, DNA, genetic code and protein synthesis
- 2.9. Fluids and electrolytes and their regulation

3. Pathology and Microbiology

- 3.1. Principles of inflammation, principles of carcinogenesis and tumour spread, coronary heart disease, infective diseases of liver and gall bladder, pathogenesis of tuberculosis
- 3.2. Immune system, immunological and serological tests for collagen vascular disease
- 3.3. Etiology and laboratory diagnosis of diseases caused by Streptococcus, Salmonella, Shigella, Vibrio. Meningococcus and hepatitis virus
- 3.4. Life cycle and laboratory diagnosis of Entamoeba histolytica, malaria parasite, Ascaris and Hookworms

4. Medicine

- 4.1. Medical management of: Headache, convulsions, coma, cerebro-vascular accidents, status asthmatics, cardio pulmonary arrest, status epileptics, acute renal failure
- 4.2. Clinical features, etiology and treatment of :Enteric fever, upper respiratory infections pneumonia, diarrhea, dysentery, hepatitis, coronary heart disease, rheumatic heart disease, cirrhosis of liver, amoebic liver abscess, peptic ulcer, pyelonephiritis, leprosy, rheumatoid arthritis, diabetes mellitus, poliomyelitis, meningitis, schizophrenia
- 4.3. Malnutrition and micronutrient deficiency states

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठ्यकम

5. Surgery

- 5.1. Principles of surgical management of severely injured and process of fracture healing.
- 5.2. Malignant tumours of stomach and their surgical management. Signs, symptoms, investigation and management of fractures of femur, principles of pre-operative and post-operative care
- 5.3. Clinical manifestations, investigations and management of: Hydrocephalus, Buerger's disease, appendicitis, benign prostatic hypertrophy, spina-bifida, bronchogenic carcinoma, carcinoma breast, carcinoma colon
- 5.4. Clinical manifestations, investigations and surgical management of: Intestinal obstruction, acute urinary retention, spinal injury, haemorrhagic shock, pneumothorax, cardiac tamponade, haemetemesis

6. Preventive and Social Medicine

- 6.1. Principles of epidemiology and health care delivery
- 6.2. Concept and general principles of prevention of disease and promotion of health
- 6.3. Organization of national health services, National health programmes (National Immunization Programme, Safe Motherhood Programme, National TB control programme, Integrated management of childhood illnesses, Leprosy Control Programme, Elimination of Lymphatic Filariasis Programme, National Vitamin A supplementation programme etc)
- 6.4. Effects of environmental pollution and climate change on health
- 6.5. Concept of balanced diet
- 6.6. Family planning methods

Section B - 20 Marks

7. Ayurved

- 7.1. Introduction to Ayurved and Astanga Ayurved
- 7.2. Principles and practice of Panchakarma including Purva and Paschat Karma
- 7.3. Introduction of Kshatra Sutra and its application.
- 7.4. Fundamental principles of Ayurveda -Tridosha, Panchamahbhutt and Saptadhatu
- 7.5. Common geriatric problems & their management
- 7.6. Principles health care ethics and professionalism
- 7.7. Khad Kriyakola and its importance in treatment
- 7.8. Vikara Anutpattikar & Vikar Prashamana Chikishaya
- 7.9. Define Ama and explain role in causing diseases
- 7.10.Etiology, clinical features and management of Kamala, Pandu Rajkshma, Raktapitta, Unmada, Aavrat and Vatrakta

8. Pharmacy

- 8.1. Patient counseling
- 8.2. Drug Interaction
- 8.3. Drug and poison information
- 8.4. Rationality of OTC drugs (over the counter drug)
- 8.5. Dose calculation and drug incompatibility

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

- 8.6. Significance of plasma concentration time profile, its measurement, pharmacy kinetic process bioavailability and its measurement and bio equivalence
- 8.7. National Drug Policy
- 8.8. Drug Act and Drug related regulations (National and International rules)
- 8.9. Good Manufacturing Practice (GMP), Good Laboratory Practice (GLP) and Good Pherucercy Practice (GPP)
- 8.10. WHO guidelines and ISO 9000

9. Nursing

- 9.1. Fundamentals of nursing: concepts of basic nursing care practices, nursing processes, safety and comfort measures, scope of nursing services, infection control, stress and coping, loss death and grieving
- 9.2. Nursing concepts, theories and principles: health and illness, stress and crisis, nursing profession, nursing theories and models
- 9.3. Community health nursing: population parameters, epidemiology, environmental sanitation, health promotion, disease prevention and communication
- 9.4. Nursing care of child, adult, older adults with acute as well as chronic health conditions, including common diagnostic tests
- 9.5. Mental health nursing: common diseases, mental status examination and therapeutic counseling
- 9.6. Midwifery and gynecological nursing: antenatal care, pregnancy, postnatal care including immunization, nutrition
- 9.7. Leadership and management: role and responsibilities of different levels of health personnel, community management: dub-health post, health post, primary health care center
- 9.8. Hospital management: district, zonal, regional hospital

10. Radiography

- 10.1.Radiographic Technique
 - 10.1.1. Routine radiographic technique for limbs, thorax, abdomen, spine and skull
 - 10.1.2. Radiographic examination with contrast media
 - 10.1.3. Contrast media- definition, types and reactions to contrast media
 - 10.1.4. Basic principle of barium study, intravenous urography, micturating and retrograde cystourethrogram, hysterosalpingogram, endoscopic retrograde cholangiopancreaticography and angiogram
- 10.2. Radiographic photography film, intensifying screen, image, film processing
- 10.3.Radiographic equipment
 - 10.3.1. Historical background of x-ray and its production
 - 10.3.2. X-ray tube construction, stationary and rotating x-ray tubes
 - 10.3.3. Imaging modalities CT, MRI, mammography, DSA, USG, etc
- **10.4. Radiation Physics**
 - 10.4.1. Production of x-ray & properties of x-rays: general radiation (Bremsstrahlung), characteristic radiation and exposure factors

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठ्यकम

- 10.4.2. Adverse effects of x-ray & safety requirements for operating an x-ray unit
- 10.4.3. Radiation protection: maximum permissible dose, tabulation of the recommended maximum permissible doses for the different parts of the body and identifying the protective materials
- 10.4.4. Radiation to patient in different diagnostic procedures (x-ray, barium, IVU, CT scan, etc.)

11. Oral Medicine and Dental Radiology

11.1.Oral Medicine

- 11.1.1. Introduction and scope of oral medicine
- 11.1.2. Patient examination, diagnostic investigations of red & white lesions of oral cavity, diseases of the tongue, infections of oral cavity
- 11.1.3. Systemic diseases and their oral manifestations and dental management
 - 11.1.3.1. Cardiovascular, respiratory, gastro intestinal, urinary diseases
 - 11.1.3.2. Blood dyscrasias and endocrine disorders

11.2.Dental Radiology

- 11.2.1. Oral and Maxillo-Facial Surgery
 - 11.2.1.1. Diagnosis of different oral conditions, management of extraction and oro-facial infections
 - 11.2.1.2. Diagnosis and management of odontogenic cysts and different types of oral tissue biopsies
 - 11.2.1.3. Principles of pain control in maxillofacial surgery, oro-facial defects cleft lip and palate, and osteomyelitis of jaw bones

11.3.Periodontics

- 11.3.1. Definition, scope, aim and objectives of periodontics
- 11.3.2. Normal periodontium, classification of diseases of periodontium
- 11.3.3. Epidemiology and etiology of periodontal diseases:
 - 11.3.3.1. Dental plaque/periodontal microbiology, material alba, food debris & stains, dental calculus, food impaction, host response
 - 11.3.3.2. Dental occlusion/trauma from occlusion/bruxism and other parafunctional habits
 - 11.3.3.3. Influence of systemic diseases on periodontium diabetes, sexhormones, hemorrhagic diseases

11.4.Orthodontics

- 11.4.1. Definition, scope and objectives of orthodontics
- 11.4.2. Growth and development: jaws, teeth, face, skull
- 11.4.3. Normal development of oral functions
- 11.4.4. Normal occlusion: development, characteristics and variation
- 11.4.5. Malocclusion: classification, etiology
- 11.4.6. Orthodontic appliances: removable, functional, and fixed
- 11.5. Prosthodontics and Crown and Bridge
 - 11.5.1. Prosthodontics

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठ्यकम

- 11.5.1.1. Examination, diagnosis, treatment planning and prognosis, retention and stability, impression making, preparation of casts, trays and temporary denture bases, methods of jaw registration and identification of artificial teeth (selection, arrangement& aesthetics)
- 11.5.1.2. Complete denture: principles of occlusion and articulation in complete dentures; steps of processing and finishing denture; correction of occlusal discrepancies; steps in delivery and adjustments of complete dentures
- 11.5.1.3. Partial dentures: scope and classification of removable partial dentures; mouth preparation, impression making & designs of removable partial dentures; principles on fabrication of cast metal framework; steps of processing, finishing, delivery and maintenance of partial dentures; and uses
- 11.5.2. Crown and Bridge
 - 11.5.2.1. Examination, diagnosis and treatment planning
 - 11.5.2.2. Principles of selection and choice of abutment teeth, principles of tooth preparation
 - 11.5.2.3. Gingival retractions and impression procedures
 - 11.5.2.4. Construction of dies and working methods
- 11.6.Conservative and Endodontics
 - 11.6.1. Conservative
 - 11.6.1.1. Patient examination, diagnosis and treatment planning in conservative dentistry and endodontics
 - 11.6.1.2. Clinical significance of dental anatomy, histology, physiology, occlusion and dental caries
 - 11.6.1.3. Principles of isolation & moisture control, and pain control
 - 11.6.1.4. Cavity preparation for various types of restorative materials
 - 11.6.2. Endodontics
 - 11.6.2.1. Pulp development, periapical pathology, tooth morphology, working length determination, cleaning and shaping the root canal system
 - 11.6.2.2. Traumatic injuries: diagnosis and management, root resorption, surgical endodontics, pulp capping and pulpotomy
 - 11.6.2.3. Endo-Perio lesions, endodontic emergencies, irrigants and medicaments

11.7. Paedodontics and Community Dentistry

- 11.7.1. Paedodontics
 - 11.7.1.1. Definition, scope and importance of paedodontics
 - 11.7.1.2. Morphology of dentitions and its application, anomalies of developing dentition, oro-facial growth and its modification
 - 11.7.1.3. Management of common dental and oral diseases, oral manifestation of systemic disease in children
 - 11.7.1.4. Common oral surgical procedures, sedation and anaesthesia used in children for dental procedures

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठ्यकम

- 11.7.1.5. Pulp therapy and space maintainer (indication, classification and techniques of fabrication)
- 11.7.2. Community Dentistry
 - 11.7.2.1. Epidemiology of oral diseases in Nepal
 - 11.7.2.2. Flurosis, systemic fluorides, topical fluorides
 - 11.7.2.3. Food that prevent dental decay
 - 11.7.2.4. Methods and media of oral health education

11.8.Oral Pathology

- 11.8.1. Developmental disorders of teeth
- 11.8.2. Dental caries, pulpitis, apical periodontitis, hypercementosis, gingivitis and periodontitis, cysts of the jaw, odontogenic tumors, infective stomatitis, oral premalignant lesion, oral cancer, common benign mucosal swelling, cervical lymphadenopathy and diseases of temporomandibular joint
- 11.8.3. Signs & symptoms of anaemia & leukamia related to oral cavity

| Uni | | | | No. | Specification | |
|----------|---------------------------------------|---------|----------------|-------------|----------------|--------------------------|
| t No. | Contents Title | Section | Weight -age | of items | I- Level (60%) | II & III- Level (40%) |
| 1. | Human Anatomy | | uge | | (0070) | (10,0) |
| 2. | Human Physiology and Biochemistry | | 15 | 15 | 9 | 6 |
| 3. | Pathology and Microbiology | | | | | |
| 4. | Medicine | A | | | | |
| 5. | Surgery | | 15 | 15 | 0 | 6 |
| 6. | Preventive and Social Medicine | | 15 | 15 | 7 | 0 |
| 7. | Ayurved | | | | | |
| 8. | Pharmacy | | 10 | 10 | 6 | 4 |
| 9. | Nursing | р | | | | |
| 10. | Radiography | D | | | | |
| 11. | Oral Medicine and Dental Radiology | | 10 | 20 | 6 | 4 |
| | Total | | 50 | 50 | 30 | 20 |

Table of Specification

Paper IV: Optional Paper- Sample MCQs of Health science

I - Level questions

- 1. Which one of the following statements is TRUE regarding Ketamine?
 - A) It causes bradycardia
 - B) It produces hypotension
 - C) It decreases myocardial oxygen consumption
 - D) It increases cardiac output

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- 2. What happens to the level of dopamine in psychosis?
 - A) Increases
 - B) Decreases
 - C) Does not change
 - D) It decreases first and increases later
- 3. Which one of the following muscles abducts vocal cords?
 - A) Lateral cricoarytenoid
 - B) Posterior cricoarytenoid
 - C) Transverse arytenoids
 - D) Thyroarytenoid
- 4. Which one of the following is NOT used in the treatment of thyroid storm?
 - A) Propranolol B) Radioactive iodine
 - C) Hydrocortisone D) Lugol's iodine
- 5. Which one the drug of choice in the treatment of gout?
 - A) Low dose aspirin B) High dose aspirin
 - C) Paracetamol D) Hydrochlorothiazine
- 6. Which one of the following immunoglobulins is the most predominant in the blood of a newborn?
 - A) IgA B) IgE C) IgG D) IgM
- 7. John Snow is known for describing the causation of which one of the following disease?A) Cholera B) Plague C) Scurvy D) Puerperal sepsis
- 8. Which one of the following statements correctly describes the status of blood pressure during different phases of pregnancy and postpartum period?
 - A) It is elevated during the first trimester
 - B) It is decreased during the second trimester
 - C) It is elevated during the third trimester
 - D) It is elevated during postpartum period
- 9. Which one of the following drugs is MOST likely cause of jaundice?A) Erythromycin B) Streptomycin C) Pyrazinamide D) Ethambutol

II & III -Level Questions

- 10. A patient has fracture of proximal shaft of ulna with ipsilateral dislocation of superior radio ulnar joint. What is it called?
 - A) Colle's fracture
 - B) Monteggia fracture dislocation
 - C) Galeazzi fracture dislocation
 - D) Essex-Lopresti fracture dislocation
- 11. Which one of the following structure or tissue is important to maintain urinary continence?
 - A) Proximal urethra sphincter
 - B) Paraurethral muscle including the Levator ani muscle complex
 - C) External sphincter
 - D) Smooth muscle of the bladder neck

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

- 12. Following conditions are associated with prolonged clotting time, EXCEPT:
 - A) Hemophilia
 - B) Liver disease
 - C) Thrombocytopinea
 - D) Christmas disease
- 13. Where are the barorecptors situated?
 - A) Aortic arch and brainstem
 - B) Aortic arch and aortic bodies
 - C) Aortic arch and carotid bifurcation
 - D) Aortic arch and hypothalamus
- 14. Karyotyping has been ordered for a girl with features of Turner Syndrome. The most important reason for this investigation is to
 - A) Avoid masculinization by treating with estrogens at puberty
 - B) Provide contraceptives after her marriage
 - C) Screen for gonadoblastoma
 - D) Find if she should be considered for growth hormone treatment
- 15. Which one of the following statements is TRUE about Rheumatic fever?
 - A) It is caused by infection of myocardium, endocardium and sometimes also of endocardium by Group A Streptococcus
 - B) It is caused by immunopathogenic process triggered by Group A Streptococcus
 - C) Latent period between streptococcal infection and development of acute rheumatic fever is two days
 - D) Components of Group A Streptococcus do not share epitopes with human cardiac proteins
- 16. A 12 year old child is prescribed oral amoxicillin for Pneumococcal pneumonia. She took the first tablet and after an hour complained of tingling sensation around her mouth. Then she became apprehensive, had difficulty in swallowing and developed hoarse voice. She was brought to emergency room with pulse rate 130, respiratory rate 32, BP 70/30 and normal temperature. The most appropriate first therapy is-
 - A) epinephrine
 - B) prednisolone
 - C) diphenhydramine
 - D) cimetidine

(The 2 items are based on following paragraph)

A 3 years old girl has presented in the emergency room with complaints of noisy breathing for the last 3 hours. There is no history of choking. On examination, the child is restless, febrile, drooling and centrally cyanosed. You can hear inspiratory and expiratory stridor.

Answer the following questions based on above paragraph:

- 17. What is the most likely diagnosis?
 - A) Laryngomalacia
 - B) Viral laryngotracheobronchitis
 - C) Acute epiglottitis
 - D) Foreign body aspiration

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- 18. What is the most likely pathogen responsible for the condition described in above paragraph?
 - A) Influenza A
 - B) Streptococcus pneumoniae
 - C) Staphylococcus aureus
 - D) Hemophilus influenzae b

(The 2 items are based on following paragraph)

A 8-month-old child presents with the complaints of 3 days of fever, 103^{0} F and diarrhea. On examination, there is mildly congested pharynx, cervical lymphadenopathy. On the fourth day, the fever subsides spontaneously and a measles like rash appears.

Answer the following questions based on above paragraph:

- 19. What is the most likely diagnosis?
 - A) Measles
 - B) Rubella
 - C) Roseola infantum
 - D) Kawasaki disease

20. Which organism is responsible for the disease described in above paragraph?

- A) Measles virus
- B) Rubella virus
- C) Human Herpes Virus
- D) Coxackie virus

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयकम

Paper IV: Optional Paper (011) – Microbiology <u>Section A - 30 Marks</u>

1. History and Development of Microbiology and Microbial World

- 1.1 Concept of the microbial world, differential characteristics of prokaryotic and eukaryotic microorganism, determinative characteristics of bacteria, viruses, fungi and protozoan parasites
- 1.2 Scope and application of microbiology, beneficial and harmful roles of microorganism, important discoveries related to development of microbiology, discovery of microscope, spontaneous generation theory, germ theory of disease and recent discoveries

2. Fundamental Biochemistry for Microbiology

- 2.1 Chemical reaction- anabolic and catabolic reactions, role of enzymes and biomolecules, types of bond in biomolecules, important biomolecules and their general properties and biological functions in microorganism i.e. carbohydrate, protein, lipids, nucleic acids, DNA- structure and function, RNA- types and function, pH and buffer, qualitative and quantitative estimation of carbohydrates lipids and fatty acids, amino acids and protein
- 2.2 Determination of acid value, saponification value, iodine number, Ninhydrin test, Biuret test, Xanthoproteic test, Caesin estimation in milk, protein precipation, separation of amino acids by paper chromatography, separation and identification of sugars, amino acids and lipids by thin layer chromatography, protein estimation by Folin-lowrey method

3. Classification, Nomenclature, Characteristics, Physiology and Growth of Bacteria

- 3.1 Application of microscopy in microbiology, working principle, application and instrumentation of compound microscope, phase contrast microscope, SEM and TEM, types of staining for bacterial identification and nature of dyes- simple staining, Gram's staining, negative staining, Flegella staining, spore staining and capsule staining and Ziehl Neelson staining
- 3.2 Basis of classification, nomenclature and characterization of bacteria according to Bergey's manual of systematic bacteriology
- 3.3 Morphological characteristics of bacterial cell and fine structure and function of cell organelles, general characteristics of common gram negative and gram positive bacteria, nutritional types of bacteria photolithotrophic, chemolithotrophic, photoorganotrophic, chemoorganotrophic, entry of nutrients, passive and active transport
- 3.4 Microbial growth, growth curve, factors affecting the growth, measurement of the bacterial growth and generation time calculation

4. Isolation, Enumeration, Identification and Typing of Bacteria

- 4.1 Types of bacteriological culture medium, techniques of isolation and enumeration of bacteria streak plate technique, pour plate technique, spread plate technique, MF, MPN, DMC, methods of anaerobiosis and anaerobic of culture of bacteria, methods of culture maintenance
- 4.2 Biochemical testing of bacteria catalase test, oxidase test, urease test, sugar fermentation, indole test, MR test, VP test, TSI test, nitrate reduction test, starch hydrolysis, lipid hydrolysis, protein hydrolysis, techniques of motility determination and micrometry, bio typing, sero typing, phage typing and molecular typing methods

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4.3 Principles of laboratory safety, decontamination and disposal of infected materials, concept of biosafty level, importance of aseptic techniques in microbiology, principles of sterilization and disinfection, control of micro-organisms by temperature, irradiation, ultrasonication, filtration, chemicals, antibiotics and other chemotherapeutic agents, working principle of hot air oven, autoclave, incubator, UV safety hood and spectrophotometer

5. Microbial Metabolism and Microbial Genetics

- 5.1 Microbial metabolism: concept of enzyme regulation in prokaryotic and eukaryotic organism, lac operon, metabolism of carbohydrate and ATP production, mechanism and significance of glycolysis, TCA cycle, fermentative pathways and electron transport system
- 5.2 Microbial Genetics: prokaryotic genome, genetic code, plasmids, concepts of bacterial and viral genetics and role of RNA & DNA, bacterial recombination-transformation, conjugation & transduction
- 6. Viruses: General structure, properties and classification schemes of animal virus and bacteriophage, virus cell interactions and viral replication, techniques of cultivation, medical importance properties, isolation, identification, enumeration and rescue of common RNA and DNA viruses

7. Eukaryotic microorganism

- 7.1 Structure, classification and general Properties of fungi, techniques of isolation, morphological identification and enumeration of common yeast and mold
- 7.2 Structure, lifecycle and general properties of common medically important fungi and Protozoan and helminthic parasites: *Candida* spp., *Cryptococcus* spp., *Histoplasma* spp., *Aspergillus* spp., malarial parasite, *Giardia* spp., *Entamoeba* spp., *Taenia* spp., asacaris and hook worm

8. Health and Disease in relation to Microbiology

- 8.1 Normal microbial flora of human body, concept of host parasite relationship, commensal and pathogenic bacteria, primary and opportunistic bacterial pathogens, virulence factor of bacterial pathogens, host parasite relationship, concept of infection and immunity, hyper sensitivity and immuno deficiency, antigen and immunogens, Antibodies and immunoglobulins
- 8.2 Common pathogenic bacteria and associated diseases: microbiology of causative organism, laboratory diagnosis, prevention and control of diseases related to E.coli, Klebsiella spp., Salmonella spp., Shigella spp., Vibrio spp., Staphylococcus spp., Mycobacterium tuberculosis, types of antibiotics, their mode of actions and spectrum, antibiotic resistance development in bacteria, antibiotic susceptibility testing of bacteria by Kirby-Bauer disk diffusion technique
- 8.3 Common pathogenic virus and associated diseases: microbiology of causative organism, laboratory diagnosis, prevention and control of polio, Japanese encephalitis, dengue, measles, influenza, HIV, rabies virus, emerging viral diseases and principle of viral vaccine production and antiviral therapy
- 8.4 Safety measures: principles of laboratory safety, principle and methods of sterilization and disinfections, decontamination and disposal of infected materials, concept of bio-safety level

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Section B - 20 Marks

9. Microbial Ecology

- 9.1 Component of microbial ecology, role of microorganisms in ecosystem, food chain, energy relations in ecosystem, microbial interactions, microbial flora of aquatic and terrestrial environment
- 9.2 Types of microbial interactions, mutualism, symbiosis, amensalism, predations, parasitisms, microbes in extreme environment, types of microorganism and survival mechanisms in extreme temperature, pH, osmotic pressure and salinity,
- 9.3 Role of microorganism in biogeochemical cycles: nitrogen cycle, carbon cycle, sulphur cycle, phosphorous cycle and other cycles of bio-elements

10. Microbiology of Water, Waste Water, Solid Waste and Air

- 10.1 Water microbiology and water pollution: distribution of microorganism in surface water and ground water, drinking water microbiology, sources of water pollution and types of pollutants and health consequence, microbiological and physicochemical parameters of water quality, fecal pollution indicator bacteria, methods of water treatment
- 10.2 Microbiology of waste water: composition of sewage and industrial effluents; preliminary, secondary and advanced treatment of sewage; types and role microorganisms in sewage treatment, sludge treatment
- 10.3 Microbiology of solid waste: types, composition and microbiology of municipal solid waste, methods of collection, transportation and disposal of solid waste and associated occupational and environmental hazards, microbiology of composting
- 10.4 Air microbiology and air pollution: types and health consequences of air pollution, sources of air pollution, fate of microorganisms in atmosphere, monitoring of air pollution, control of air pollution

11. Soil and Agriculture Microbiology

- 11.1 Microbiology of methanogenic microorganism and biogas production
- 11.2 Biodegradation of soil pollutants and role of microorganisms in degradation of pesticides and xenobiotics
- 11.3 Biodegradation of agricultural wastes and role of bacteria and fungi in enzymatic degradation of cellulose, hemicellulose, starch, pectin and chitin
- 11.4 Soil microorganisms their role in agriculture: bacteria, fungi, actinomycetes and cyanobacteria, factors influencing their growth and activities, rhizospheric and phyllospheric microorganisms, role of microorganisms as biofertilizer and in crop production

12. Microbial biotechnology

- 12.1 Scope and applications microbial biotechnology, risk and hazards of biotechnology
- 12.2 Techniques of plant tissue culture, mushroom culture, types and potentials of microorganisms as biofertilizers Isolation and characterization of rhizobium, azotobacter and mycorhiza
- 12.3 Types of Fermentation solid state fermentation, submerged state fermentation, fermenter designs, concept of fermentation, microbiology of lactic acid bacteria

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and their applications in dairy industries, meat and meat product industries, bakery and beverage industries, for SCP production and as probiotics, screening of wine yeast, industrial production process of beer, wine, ethanol, and acetic acid, techniques of milk pasteurization, microbiology of production of cheese, yogurt and ice-cream and improvised dairy products, industrially important enzymes and producing microorganisms, advantage of microbial enzymes, isolation screening and characterization of enzyme producing microorganisms and production, extraction, purification and estimation of proteases, amylases, chitinase, pectinase and other industrially important enzymes

- 12.4 Concept of genetic engineering, scope and applications, technique of gene manipulation, outline of gene cloning
- 12.5 Safety measures: principles of laboratory safety, principle and methods of sterilization and disinfections, decontamination and disposal of infected materials, concept of bio-safety level

13. Microbiology of Food, Food Perseveration and Food Poisoning

- 13.1 Primary sources of food contamination; types, characteristics and physiology of facultative anaerobic and anaerobic bacteria, molds, yeasts; factors affecting microbial growth in food: intrinsic parameters, extrinsic parameters
- 13.2 Safe food handling, microbiology of food spoilage: fruits and vegetables, fresh and processed meat and poultry product, milk and milk products, canned foods, cereals, bakery products, fermented foods, fruit Juice, soft drinks and beer
- 13.3 Principles and methods of food preservation- chemical, irradiation, low temperature, high temperature, drying, canning
- 13.4 Role of microorganisms in food poisoning: concept of food borne infections and intoxications, food poisoning by gram positive and gram negative bacteria, gasteroenteritis caused by Vibrio, *Salmonella* and E. *coli*, *Mycotoxins*

14. Food Quality Control

- 14.1 Concept of quality control systems in food industries, conventional quality control, quality assurance and HACCP concept
- 14.2 National food regulatory system, food act and food regulations
- 14.3 National microbiological standards of food products: milk and milk products, drinking water and fruit juice, indicators of sanitary quality of food products

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| No | Contents Title | Section | -age | of | I -Level | II & III - Level | | |
| 110. | | | -age | items | (60%) | (40%) | | |
| 1. | History and Development of | | | | | | | |
| | Fundamental Biochemistry for | | | | | | | |
| 2. | Microbiology | | | | | | | |
| | Classification, Nomenclature, | | 15 | 15 | 0 | 6 | | |
| 3. | Characteristics, Physiology and | | 15 | 15 | 9 | 0 | | |
| | Growth of Bacteria | | | | | | | |
| | Isolation, Enumeration, | | | | | | | |
| 4. | Identification and Typing of | Α | | | | | | |
| | Bacteria | | | | | | | |
| 5 | Microbial Metabolism and | | | | | | | |
| 5. | Microbial Genetics | | | | | | | |
| 6. | Viruses | | 15 | 15 | Q | 6 | | |
| 7. | Eukaryotic microorganism | | 15 | 13 | | 0 | | |
| Q | Health and Disease in relation to | | | | | | | |
|). | Microbiology | | | | | | | |
| 10. | Microbial Ecology | | | | | | | |
| 11 | Microbiology of Water, Waste | | 10 | 10 | 6 | 1 | | |
| 11. | Water, Solid Waste and Air | | 10 | 10 | 0 | | | |
| 12. | Soil and Agriculture Microbiology | B | | | | | | |
| 8. | Microbial biotechnology | D | | | | | | |
| 13. | Microbiology of Food, Food | | 10 | 10 | 6 | 4 | | |
| | Perseveration and Food Poisoning | | 10 | 10 | 0 | т | | |
| 14. | Food Quality Control | | | | | | | |
| | Total | | 50 | 50 | 30 | 20 | | |
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Paper IV: Optional Paper- Sample MCQs of Microbiology

I - Level Questions

- 1. Niacin test is one of the determinative tests for identification of
 - A) *Campylobacter* spp.

B) Mycobacteriukm tuberculosis

C) Histoplasma capsulatum

D) Candida albicans

- 2. Lecithin is known as
 - A) Phosphatidylinositol
 - B) Phosphatidylcholine
 - C) Phosphatidylethanolamine
 - D) Phosphatidylserin
- 3. Flagella rotation can move bacteria through liquid media at speeds of
 - A) 60 cells lengths/second
 - B) 120 cell lengths/second
 - C) 150 cell lengths/second
 - D) 200 cell lengths/second

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II & III -Level Questions

- 4. In Miles and Mishra (1938) technique the small drops (0.02ml) of sample or dilutions are placed on agar plates from the height of
 - A) Not more than 2 cm
 - B) Not more than 5 cm
 - C) Not less than 5 cm
 - D) None of the above
- 5. Efficiency of autoclaving is monitored using indicators
 - A) Bacillus stearothermophilus ATCC 7935
 - B) Clostridium sporogens ATCC7955
 - C) Both A and B
 - D) None of the above
- 6. Negative-stranded RNA viruses encode and package their own
 - A) RNA-dependent RNA polymerase
 - B) DNA polymerase
 - C) DNA dependent RNA polymerase
 - D) RNA dependent DNA polymerase
- 7. Lyophilization and Ultra sonication methods of microbial cell disruption are
 - A) Physical methods
 - B) Biological and physical technique respectively
 - C) Chemical and physical method respectively
 - D) Physical and chemical method respectively
- 8. Succinyl-CoA is formed in TCA cycle after
 - A) reductive decarboxylation of succinate
 - B) reductive decarboxylation of α -ketoglutarate
 - C) oxidative decarboxylation of α -ketoglutarate
 - D) oxidative decarboxylation of succinate
- 9. Psychrophiles have enzymes consisting of
 - A) Greater polar and lesser hydrophobic amino acid contents
 - B) Lesser polar and lesser hydrophobic amino acid contents
 - C) Greater polar and greater hydrophobic amino acid contents
 - D) Lesser polar and greater hydrophobic amino acid contents
- 10. The order of *Shigella* spp. according to decreasing pathogenicity is
 - A) S. dysenteriae, S. flexneri, S. boydii, S. sonnei
 - B) S. sonnei, S. boydii, S. flexneri, S. dysenteriae
 - C) S. flexneri, S. dysenteriae, S. boydii, S. sonnei
 - D) S. dysenteriae, S. flexneri, S. sonnei, S. boydii

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

11. If the atomic weight of Sodium (NA) is 22.99gram and Chlorine (Cl) is 35.45gram. What is the molecular weight of NaCl.

| A) | 58.44 | B) 68.44 |
|----|-------|----------|
| B) | 78.44 | D) 98.44 |

- 12. For the preparation of 1M solution of the NaOH what amount of NaOH should be dissolved in 1 litre of water?
 - A) 40g/l
 - B) 80g/l
 - C) 20g/l
 - D) 160g/l

13. Which of the following is the correct order of the steps of PCR

- A) heat denaturation, annealing and extension of melted primer by DNA polymerase
- B) annealing , extension of melted primer by DNA polymerase and heat denaturation
- C) annealing, heat denaturation and extension of melted primer by DNA ligases
- D) extension of melted primer by DNA polymerase, annealing and heat denaturation
- 14. Glycerol stocks are made for preservation of stock cultures. The procedure is to
 - A) Make heavy suspension in 30% glycerol in 1 % peptone water and distribute in small vial and freeze at 20^0
 - B) Make the heavy suspension in 100% glycerol and distribute in small vial and freeze at 20^0
 - C) Make the heavy suspension 1% glycerol and 1% peptone and distribute in small vial and freeze at 20^{0}
 - D) Make the heavy suspension 2% glycerol 1% peptone and distribute in small vial and freeze at 20^{0}
- 15. The correct sequence for the viral life cycle is:
 - A) attachment, biosynthesis, penetration, maturation, release
 - B) penetration, biosynthesis, attachment, maturation, release
 - C) attachment, penetration, biosynthesis, maturation, release
 - D) biosynthesis, attachment, penetration, maturation, release

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Paper IV: Optional Paper (012) – Physics

Section A - 25 Marks

1. Mechanics

- 1.1 Gravitation: Gravitational field and potential, gravitational self-energy, motion of variable mass, motion of rockets
- 1.2 Oscillatory Motion: Simple harmonic oscillation, energy of a harmonic oscillator, spring and mass system, simple and compound pendulum, torsional pendulum, Helmholtz resonator, oscillation of two masses connected by a spring, normal modes, N coupled oscillators, damped and forced harmonic oscillator, power dissipation, quality factor, transient and steady states, power absorption
- 1.3 Elastic Properties: Interrelation between elastic constants, twisting couple, bending moment, cantilever, supported beams
- 1.4 Fluid Mechanics: Equation of continuity, Bernoulli's theorem, viscosity, Poiseulle's law, Reynold's number
- 1.5 Motion in Central Force Field: Two body problem and the reduced mass, equation of orbits, Kepler's laws of planetary motion
- 1.6 Collision: Collision in laboratory and center of mass systems, scattering cross section, Rutherford scattering
- 1.7 Lagrangian Formulation: Constraints, generalized co-ordinates, D'Alembert's principle, Langrange's equation, cyclic coordinates
- 1.8 Inertial and Non-inertial Frames: Translating and rotating co-ordinate systems, Coriolis effect, Foucault pendulum
- 1.9 Rigid Bodies: General theorems of moment of inertia, calculation of moment of inertia of symmetrical objects, energy of rotation; Euler's theorem, Euler angles, angular momentum and kinetic energy, the inertia tensor, Euler's equation of motion, torque free motion, symmetrical top
- 1.10 Relativity: Galilean invariance, Galilean transformations, Michelson-Morley experiment, Lorentz transformation, length contraction, time dilation, velocity addition, relativistic mass, mass-energy relation, relation between momentum and energy

2. Thermodynamics

- 2.1 Laws of Thermodynamics: Concept of work, internal energy and thermodynamical processes, Carnot's theorem, entropy changes, entropy and second law, triple point, thermodynamic potentials, Maxwell's thermodynamic relations
- 2.2 Ideal and Real Gases: Joule's law for perfect gas, van der Waals equation, critical constants, thermodynamics of refrigeration, cooling in Joule-Thomson expansion, Boyle's temperature, temperature of inversion
- 2.3 Transport Phenomenon: Mean free path, viscosity, thermal conductivity, diffusion, Brownian motion
- 2.4 Black Body Radiation: Kirchoff's law, pressure of radiation, pressure of diffusive radiation, Stefan-Boltzmann's law, Wien's displacement law, Planck's radiation law
- 2.5 Statistical Mechanics: Phase space, microstate and macrostates, ensemble, entropy and thermodynamical probability, fundamental postulates of statistical mechanics, Maxwell's distribution law of velocities, Maxwell-Boltzmann statistics, law of equipartition of energy, Bose-Einstein and Fermi-Dirac statistics, electron in metals, Fermi level and energy

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खुला प्रतियोगितात्मक परीक्षाको पाठ्यकम

3. Electricity and Magnetism

- 3.1 Electrostatic Potential and Field: The electric field, Gauss's law and it's applications, electric dipole, dipole in external electric field, divergence of E, Poisson's and Laplace's equations, curl of E, electrical images, scalar potential
- 3.2 Electrostatic Field in Dielectric: Electric polarization, electrostatic fields in dielectric media, Gauss's law in a dielectric media, relation of D, E, P and boundary conditions, electric susceptibility, dielectric constant, molecular field in a dielectric, atomic polarizability, Clausius-Mossotti relation, Langevin Debye formula
- 3.3 Magnetic Properties and Fields: Biot and Savart's law and its applications, Lorentz force, force between parallel conductors, Ampere's circuital law, magnetic dipole, magnetic vector and scalar potential, magnetization, relation of B, H and M, permeability and susceptibility, boundary conditions on B and H
- 3.4 Electromagnetic Induction: Faraday's law, self and mutual inductions, transformer
- 3.5 LCR Circuit: LCR circuits with AC and DC sources, resonances in series and parallel circuits, the quality factor, power factor
- 3.6 Maxwell's Electromagnetic Equations: The displacement current, Maxwell's equations and electromagnetic wave equations, Poynting theorem and Poynting vector

4. Optics

- 4.1 Wave Nature of Light: Huygen's wave theory and its application
- 4.2 Aberration at Spherical Surfaces: Chromatic aberration; astigmatism, Ramsden's and Huygen's eyepieces
- 4.3 Interference: Coherence, interference, Fresnel's biprism, Lloyd's mirror, thin films, wedge shape, Newton's ring, Michelson interferometer, intensity distribution
- 4.4 Diffraction: Fresnel diffraction: zone plate, circular aperture; Fraunhoffer's diffraction: diffraction through a single and double slit, dispersive and resolving power of grating, microscope and telescope
- 4.5 Polarization: Plane, circular and elliptically polarized light, double refraction, crystal polarizer, Malus law, polarization by reflection and scattering, double refraction and Huygen's explanation, production and analysis of polarized light, optical activity, Laurent half shade polarimeter and its applications
- 4.6 Dispersion and Scattering: Normal and anomalous dispersion, scattering of light
- 4.7 Lasers: Ruby and He-Ne lasers, Holography

Section B- 25 Marks

5. Atomic and Nuclear Physics

- 5.1 Atomic Structure: Rutherford scattering, Bohr's hydrogen atom, Frank-Hertz experiment, Sommerfeld non-relativistic atom, space quantization, vector atom model, LS coupling, Pauli's exclusion principle
- 5.2 Fine Structure Spectrum: Fine structure of hydrogen lines, doublet structure of alkali spectrum, single and triple series of alkaline earth atoms, normal and anomalous Zeeman effect for one-electron system
- 5.3 X-rays: Characteristic X-ray spectrum, X-ray diffraction, X-ray spectrometer, fine structure, Moseley's law and its application
- 5.4 Properties of the Nucleus: Proton-electron hypothesis, proton-neutron hypothesis, nucleus, binding energy and nuclear stability, nuclear reactions, Q-value, threshold energy

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- 5.5 Radioactivity: Half-life and mean life, successive radioactive transformations, equilibrium, natural radioactive series, alpha, beta and gamma ray spectra, absorption of α particles, theory of α decay, theory of β -decay
- 5.6 Interaction of Electromagnetic Radiation with Matter: Absorption, photoelectric effect, Compton scattering, pair production, measurement of γ -ray energies
- 5.7 Accelerator and Detectors: Geiger-Müller counter, scintillation counter, cyclotron, betatron, linear accelerator
- 5.8 Nuclear Reactors: Fission reactors, critical size, proton-proton chain, carbonnitrogen cycle, controlled thermonuclear fusion
- 5.9 Nuclear Models: Liquid drop model, magic numbers, shell model and its predictions, energy level scheme
- 5.10 Elementary Particles: Cosmic rays, meson theory of nuclear forces, classification of elementary particles and their interactions, conservation laws, quark model

6. Electronics

- 6.1 Circuit Analysis: Superposition theorem, Thevenin's and Norton's theorems, maximum power transfer theorem
- 6.2 Diodes: Energy band in semiconductors, diode characteristics, half and full wave rectifiers, bridge rectifier, R-C filter, Zener diode
- 6.3 Transistors: PNP and NPN transistors, α and β of transistor, characteristics of CB, CE and CC amplifiers, input impedance, output impedance, Q-point, bias stabilization, stability factor, characteristics of FET and UJT
- 6.4 Amplifiers: R-C amplifier, frequency response, power amplifier, differential and operational amplifiers, transfer characteristics, inverting and non-inverting mode, common mode rejection ratio
- 6.5 Oscillators: Negative and positive feedback, Barkhausen criterion, working principle of Hartley, Colpitt's and phase shift oscillators, multivibrators
- 6.6 Logic gates and Digital Electronics: Decimal, arithmetic and binary numbers, Boolean algebra and de-Morgan's theorem, logic gates, flip-flops, half adders and full adders

7. Solid State Physics

- 7.1 Crystals: The crystalline types of solid, lattice translational vector, symmetry operations, basis vector, fundamental types of lattices, Miller indices, simple crystal structures, X-ray diffraction, Bragg's law, Laue method, Brillouin zone, reciprocal lattice, equilibrium lattice constant, ionic, covalent, metallic and hydrogen bonding, lattice energy, dislocations, slip
- 7.2 Lattice Dynamics: Lattice vibration, phonon spectrum, lattice specific heat capacity, Dulong and Petits relation, Einstein theory, Debye's theory
- 7.3 Free Electron Theory: Density of states, Fermi energy, electron specific heat capacity, relaxation time, mean free path, mobility, thermal conductivity, electrical conductivity, Hall effect
- 7.4 Band Structure of Crystals: Energy bands in solids, valence and conduction band, conductor, insulator and semiconductor on the basis of band theory

8. Quantum Mechanics

8.1 Introductory Wave Mechanics: de Broglie hypothesis, Davisson-Germer experiment, wave-particle duality, uncertainty principle, wave-packet, group and phase velocity

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- 8.2 Quantum Mechanical Wave Propagation: Time dependent and time independent Schrödinger equation, meaning of the wave function (Ψ), probability density and probability current density, normalization of wave function, box normalization, expectation values, Ehrenfest theorem
- 8.3 Operator Formalism: Commuting and non-commuting operators, Hermitian operators, eigenfunctions and eigenvalues of operators, degeneracy, postulates of quantum mechanics, principle of superposition, system of orthogonal functions, expansion in eigenfunctions, simultaneous eigenfunctions and commutators, the parity operator, commutation rules and the uncertainty principle
- 8.4 Barrier Penetration: Free particle, potential step, potential barrier, bound states, infinite potential well, linear harmonic oscillator, zero point energy
- 8.5 Quantum Mechanical Problems: Schrödinger equation for spherically symmetric potential, spherical harmonics, angular momentum operator, parity, solution of Schrödinger equation for hydrogen atom, probability densities of electrons and shape of orbitals, transition probabilities and selection rules

9. Mathematical Physics

- 9.1 Vector Analysis: Vector algebra, differentiation and integration, gradient, divergence and curl, Gauss, Stoke and Green theorems
- 9.2 Tensor Analysis: Moment of inertia and stress tensors, contravariant, covariant and mixed tensors, addition, multiplication and contraction
- 9.3 Matrix Algebra: Hermitian, unitary and orthogonal matrices, inverse transformation, similarity transformation, eigenvalue and eigenvector, diagonalization
- 9.4 Fourier Analysis: Fourier series, Dirichlet conditions, even and odd functions, square, triangular and saw-tooth waves, summing of Fourier series
- 9.5 Integral Transforms: Fourier transforms, Laplace transforms and their applications
- 9.6 Differential Equations: Power series solution of Bessel, Legendre, Hermite and Laguerre equations

| The:4 | | | Weight | No. | Specification | | |
|-------|---------------------------|---------|--------|-------------|-------------------|--------------------------|---|
| No. | Contents Title | Section | -age | of items | I -Level (60%) | II & III- Level (40%) | |
| 1. | Mechanics | | 15 | 15 | 0 | 6 | |
| 2. | Thermodynamics | Α | Α | 15 | 15 | 9 | 0 |
| 3. | Electricity and Magnetism | | | 10 | 10 | 6 | 1 |
| 4. | Optics | | 10 | 10 | 0 | 4 | |
| 5 | Atomic and Nuclear | | | | | | |
| 5. | Physics | | 10 | 10 | 6 | 4 | |
| 6. | Electronics | ъ | | | | | |
| 7. | Solid State Physics | D | | | | | |
| 8. | Quantum Mechanics | | 15 | 15 | 9 | 6 | |
| 9. | Mathematical Physics | | | | | | |
| | Total | | 50 | 50 | 30 | 20 | |

Table of specification

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लोक सेवा आयोग अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तुतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

Paper IV: Optional Paper- Sample MCQs of Physics

I - Level Questions

1. Potential energy (U) of a particle changes from point to point. The particle experiences a conservative force, \vec{F} , given by the relation

C) $\vec{F} = \nabla^2 U$ D) $\vec{F} = -\nabla U$ A) $\vec{F} = \nabla U$ B) $\vec{F} = -\nabla^2 U$

 $\delta \int (T-V)dt = 0$ represents the 2. A) principle of virtual work

C) D'Alembert's principle

B) Hamilton's principle D) principle of least action

- 3. A particle leaving a cyclotron has a total relativistic energy of 10 GeV and a relativistic momentum of 8 GeV/C. What is the rest mass of this particle? A) $0.25 GeV/C^2$ B) $6.00 GeV/C^2$ C) $1.2 GeV/C^2$ D)16.0*GeV* / C^2
- 4. An ideal gas is taken through a series of changes represented in the diagram. The net work done by the gas in the complete cycle is equal to



5. The efficiency of a carrot engine does not change when the source temperature (T_H) is increased by \mathcal{G}_1 , and the sink temperature (T_c) is decreased by \mathcal{G}_2 . Which one of the following is true?

A)
$$T_c \mathcal{G}_1 = -T_H \mathcal{G}_2$$
 B) $T_c \mathcal{G}_1 = T_H \mathcal{G}_2$ C) $T_c \mathcal{G}_2 = -T_H \mathcal{G}_1$ D) $T_c \mathcal{G}_2 = T_H \mathcal{G}_1$

II & III - Level Questions

- 6. A convex lens makes real image of a point situated on the optic axis. If the upper-half part of the lens is covered, what will happen to the image?
 - A) The image will be displaced downward.
 - B) The image will be displaced upward.
 - C) The image will be displaced on the optic axis.
 - D) The image will not be displaced.

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7. Choose the correct match from the given columns. The symbols carry usual meanings.

| a) Bose-Einstein statistics | 1) $n_i = g_i / e^{\alpha + \beta \epsilon_i}$ |
|---------------------------------|---|
| b) Fermi-Dirac statistics | 2) $n_i = g_i / \left(e^{\alpha + \beta \epsilon_i} - 1 \right)$ |
| c) Maxwell-Boltzmann statistics | 3) $n_i = g_i / \left(e^{\alpha + \beta \epsilon_i} + 1 \right)$ |
| | |

- A) a 1, b 2, c 3 C) a - 3, b - 1, c - 2 B) a - 2, b - 3, c - 1 D) a - 3, b - 2, c - 1
- 8. Consider the propagation of electromagnetic wave along *x*-axis in which electric field \vec{E} and magnetic field \vec{B} vibrate along *y*-axis and *z*-axis respectively. If \vec{E} and \vec{B} vary with *x* and *t* only, then select the correct ones from the following expressions

a)
$$\frac{1}{c^2} \frac{\partial E_y}{\partial t} = -\frac{\partial B_z}{\partial x}$$
 b) $\frac{\partial B_z}{\partial t} = -\frac{\partial E_y}{\partial x}$ c) $\frac{1}{c^2} \frac{\partial E_y}{\partial t} = -\frac{\partial B_z}{\partial t}$ d) $\frac{\partial E_y}{\partial x} = -\frac{\partial B_y}{\partial t}$

- A) a and b are correctB) b and c are correctD) d and a are correct
- 9. Find the thickness of quarter wave plate when the wavelength of light is 5890 Å, $\mu_E = 1.553$, $\mu_o = 1.544$.
 - A) 1.550×10^{-3} cm B) 1.505×10^{-2} cm C) 1.636×10^{-3} cm D) 1.550×10^{-4} cm
- 10. Two radioactive samples A and B of initial mass 1 kg have their half-lives 3 days and 4 days respectively. The ratio of mass of A to that of B after 12 days will be
 A) 1:1
 B) 1:2
 C) 2:1
 D) 1:4
- 11. Hartley oscillator has $L_1 = 100 \ \mu\text{H}$, $L_2 = 1 \ \text{mH}$, mutual inductance between coils M = 20 μH and C = 20 pF then the frequency of oscillation is
 - A) 1052 Hz B) 1052 kHz C) 1052 MHz D) 1052 GHz
- 12. In the following circuit $V_0 = 2V$ and V = 2V. What is the current flowing through the diode?



- 13. Which of the following statements are true for a Hermitian matrix?
 - *i*) It coincides with its transpose.
 - *ii*) It coincides with its conjugate transpose.
 - iii) Its every element is complex.
 - iv) Its diagonal elements are real.

A) *i* and *iii* B) *i* and *iv* C) *ii* and *iii* D) *ii* and *iv*

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14. Choose the correct match from the given columns.

- a) Bessel polynomial
- b) Hermite polynomial 2) Cylindrical problem
- c) Lagaurre polynomial 3) Harmonic oscillator problem
- d) Legendre polynomial 4) Spherical symmetric problem

| A) a - 1, b - 2, c - 3, d - 4 | B) a - 2, b - 3, c - 1, d - 4 |
|-------------------------------|-------------------------------|
| C) a - 4, b - 3, c - 2, d - 1 | D) a - 2, b - 3, c - 4, d - 1 |

15. The figure shown below represents the pattern of lines of force of vector fields \vec{F}_1 and \vec{F}_2





1) Central force problem

Which of the following statements are true?

| i) $\nabla \cdot \vec{F}_1 = 0$ everywhere | ii) $\nabla \cdot \vec{F}_2 = 0$ everywhere |
|---|--|
| iii) $\nabla \times \vec{F}_1 = 0$ everywhere | iv) $\nabla \times \vec{F}_2 = 0$ everywhere |

A) i and ii

B) ii and iii

C) iii and iv

D) iv and i

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Paper IV: Optional Paper (017) – Zoology <u>Section A - 25 Marks</u>

1. Lower Non-chordata

- 1.1. Important features of phyla of lower non-chordates (Protozoa, Porifera, Coelenterata, Platyhelminthes, Nemathelminthes and Annelida) and classification up to orders with characters and examples
- 1.2. Introduction and origin of Metazoa
- 1.3. Habit, habitat, distinguishing characters and economic importance of the followings:
 - 1.3.1. Entamoeba, Trypanosoma, Giardia, Vorticella, Opalina, Balantidium, Nyctotherus, Noctiluca
 - 1.3.2. Leucosolenia, Spongilla, Euplectella, Hyalonema, Euspongia, Chalina
 - 1.3.3. Sertularia, Tubularia, Bougainvillea, Physalia, Millepora, Aurelia, Adamsia, Metridium and corals (Alcyonium, Tubipora, Zoanthus, Favia, Fungia, Corallium)
 - 1.3.4. Dugesia, Schistosoma, Hymenolepis
 - 1.3.5. Enterobius, Ancylostoma, Trichinella,
 - 1.3.6. Nereis, Arenicola, Aphrodite, Amphitrite, Eunice, Chaetopterus, Polynoe, Tubifex, Pontebdella and Hirudo
- 1.4. Detail study of *Monocystis*
- 1.5. Canal system and skeletal system in Porifera
- 1.6. Detail study of *Sycon*
- 1.7. Polymorphism in Coelenterata and detail study of Obelia
- 1.8. Detail study of *Hirudinaria granulosa*

2. Higher Non-chordata & Hemichordata

- 2.1 Important features of phyla of Arthropoda, Mollusca, Echinodermata and Hemichordata and classification up to orders with characters and examples
- 2.2 Habit, habitat, distinguishing characters and economic importance of the followings:
 - 2.2.1 Peripatus, Lobster, Cancer, Sacculina, Eupagurus, Daphnia, Cyclops, Lepas, Balanus, Apus, Lepisma, Gryllus, Mantis, Cicada, Forficula, Epiophlebia (Dragon fly), Julus, Scolopendra, Palamnaeus, Aranea, Limulus
 - 2.2.2 Neomenia, Neopilinia, Chiton, Anodonta, Ostrea, Solen, Pecten, Haliotis, Patella, Aplysia, Doris, Limax, Dentalium, Nautilus, Octopus, Sepia, Loligo, Achatina, Anademes, Lamellidens
 - 2.2.3 Pentacerous, Ophiura, Echinus, Cucumaria, Antedon
 - 2.2.4 Saccoglossus, Rhabdopleura and Cephalodiscus
- 2.3 Mouth parts of insects: biting and chewing type, sponging type, siphoning type, chewing and lapping type, piercing and sucking type
- 2.4 Detail study of Pila and Asterias
- 2.5 Economic importance of Mollusca
- 2.6 Detail study of *Balanoglossus* and its affinities

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3. Chordata (Poikilotherms)

- 3.1 Protochordata
 - 3.1.1 Important features of Protochordates (Urochordates and Cephalochoradates) and classification up to orders with characters and examples
 - 3.1.2 Habit, habitat, distinguishing characters and economic importance of the followings:
 - 3.1.2.1 Ciona, Botryllus, Pyrosoma, Doliolum, Salpa, Oikopleura
 - 3.1.2.2 Asymmetron
 - 3.1.3 Detail study of *Herdmania*
 - 3.1.4 Detail study of Branchiostoma
- 3.2 Vertebrata
 - 3.2.1 Important features of vertebrates (Cyclostomata, Pisces, Amphibia and Reptilia) and classification up to orders with characters and examples
 - 3.2.2 Geographical distribution, habit, habitat, distinguishing characters and economic importance of the followings:
 - 3.2.2.1 Petromyzon, Myxine
 - 3.2.2.2 Scoliodon, Sphyrna, Pristis, Trygon, Rhinobatus, Chimaera, Protopterus, Polypterus, Acipenser, Lepidosteus, Mystus, Tetrodon, Echeneis, Solea
 - 3.2.2.3 Ichthyophis, Ambystoma, Axolotl larva, Triton, Salamandra, Amphiuma, Necturus, Bufo, Hyla, Rhacophorus
 - 3.2.2.4 Chelone, Kachuga, Testudo, Sphenodon, Gecko, Hemidactylus, Calotes, Draco, Heloderma, Phrynosoma, Chaemeleon, Varanus, Typhlops, Python, Bungarus, Naja, Viper, Hydrophis, Crocodilus and Gavialis
 - 3.2.3 Detail study of Labeo rohita
 - 3.2.4 Origin of Amphibia, parental care in Amphibia
 - 3.2.5 External features and functional anatomy of *Calotes*. Identification of poisonous and non-poisonous snakes, biting mechanism of snake, nature of snake venom and its action, first aid treatment on snake bite
 - 3.2.6 Histological study of skin, stomach, intestine, liver, pancreas, lung, kidney, spinal cord, ovary and testis of frog

4. Chordata (Homeotherms)

- 4.1 Important features of vertebrates (Aves and Mammalia) and classification up to orders with characters and examples
- 4.2 Geographical distribution, habit, habitat, distinguishing characters and economic importance of the followings:
 - 4.2.1 Rhea, Apteryx, Aptenodytes (Penguin), Passer (House Sparrow), Corvus (House Crow), Psittacula (Parrot), Gallus (Fowl), Eudynamis (Koel), Epupa (Hoopoe), Milvus (Kite), Pseudogyps (White Backed Vulture), Ardea (Heron), Lophophorus (Danphe), Pavo (Peacock), Tyto (Barn Owl), Casuarius
 - 4.2.2 Ornithorynchus (Duck-billed Platypus), Echidna (Spiny anteater), Macropus (Kangaroo), Talpa (Mole), Herpestes (Mongoose), Megaderma (Bat), Pteropus (Flying Fox), Galeopithecus (Flying Lemur), Bradypus (Three-toed Sloth), Manis (Scaly anteater), Cavia (Guinea Pig), Platenista (Dolphin), Balaenoptera (Blue Whale), Rhitina (Sea Cow), Panthera

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(Tiger), *Phoca* (Seal), *Elephas* (Elephant), *Equas* (Horse), *Rhinoceros*, *Moschus* (Musk Deer)

- 4.3 Pheasants of Nepal
- 4.4 Detail study of *Columba livia*
- 4.5 Detail study of *Oryctolagus cunniculus*
- 4.6 Histological study of skin, stomach, intestine, liver, pancreas, lung, kidney, spinal cord, ovary and testis of rabbit

5. Physiology (with reference to man) and Biostatistics

- 5.1 Physiology of digestion: composition, function and regulation of salivary, gastric, pancreatic, bile and intestinal fluid
- 5.2 Physiology of respiration: transport of oxygen and carbon dioxide; Bohr's effect
- 5.3 Physiology of circulation: composition of blood and lymph; structure and function of heart
- 5.4 Physiology of excretion: nephron and regulation of urine formation; osmoregulation and excretory products
- 5.5 Neuron: nerve impulse- its conduction and synaptic transmission.
- 5.6 Endocrinology: structure and function of pituitary, thyroid, parathyroid, pancreas and adrenal glands
- 5.7 Biostatistics: introduction, types of biological data, population, sample, sampling, measure of central tendency and probabilities

Section B - 25 Marks

6. Cell Biology, Developmental Biology, Evolution and Genetics

- 6.1 Cell Biology: structure and function of cell and its organelles, cell division, chromosome structure and types, linkage and crossing over
- 6.2 Developmental biology: gametogenesis, types of eggs, fertilization, parthenogenesis, cleavage, gastrulation and germ layers & their derivatives and homologies
- 6.3 Development of *Amphioxus*, chick and rabbit
- 6.4 Evolution: evidences of organic evolution. Darwinism and Neo-Darwinism
- 6.5 Genetics: modern concept of gene, genetic code, gene mutations and mutagenesis, structure and function of DNA and RNA, DNA replication, sex chromosomes, sex determination in Drosophila and man, sex linked inheritance, DNA as a tool for forensic investigation, concept of polymerase chain reaction, congenital abnormalities in man (Down's syndrome, Albinism and Colour blindness)

7. Ecology, Wildlife, Zoogeography and Animal Behavior

- 7.1 Ecology: components of ecosystem, energy flow, biogeochemical cycles (carbon and nitrogen), theories of population growth, consequences of over population, pollution and their control measures
- 7.2 Wild life: protected area systems of Nepal, major faunal diversity of Nepal, importance of wildlife management, threatened mammals of Nepal and their conservation practices
- 7.3 Zoogeography: major zoogeographical realms and their characteristic fauna
- 7.4 Animal behavior: innate and learned behavior, territorial behavior, social behavior, reproductive behavior, general pattern of migration in fish and birds

8. Medical Zoology

- 8.1 Vectors of diseases and control of vectors
- 8.2 Antigens, antibodies and vaccines

अप्राविधिक (न्याय, परराष्ट्र, प्रशासन, लेखापरीक्षण र संसद सेवा), राजपत्रांकित तृतीय श्रेणी, शाखा अधिकृत वा सो सरह पदको खला प्रतियोगितात्मक परीक्षाको पाठयक्रम

- 8.3 Introduction, characteristics, mode of transmission, pathogenesis and control measures of human diseases or the disease causative agents:
 - 8.3.1 Viruses: chicken-pox, yellow-fever, plague, dengue, polio and AIDS
 - 8.3.2 Bacteria: *Rickettsia, Spirochetes*, typhoid, cholera and tuberculosis
 - 8.3.3 Fungi: ringworm (Tinea)
 - 8.3.4 Protozoan parasites: *Plasmodium* spp., *Entamoeba histolytica*, *Giardia lamblia* and *Leishmania donovani*
 - 8.3.5 Platyhelminthes: Fasciolopsis buski, Taenia solium and Echinococcus granulosus
 - 8.3.6 Nemathelminthes: Ascaris lumbricoides and Wuchereria bancrofti
 - 8.3.7 Zoonotic diseases: rabies, SARS, bird flu and swine flu
 - 8.3.8 Non-communicable disease: cancer

9. Fish and Fisheries

- 9.1 Water resources of Nepal: lentic (ponds, wetland, lakes and reservoirs) and lotic (rivers of Nepal)
- 9.2 Abiotic factors: physical factors, chemical factors alkalinity and nutrients (nitrates and phosphates)
- 9.3 Biotic factors Planktons
- 9.4 Fish diseases: Gill Rot Disease, Dropsy, Dactylogyrosis and Gyrodactylosis.
- 9.5 Characters and distribution of Dipnoi
- 9.6 Economic importance of fishes
- 9.7 Introduction to fishes of Nepal
 - 9.7.1 Cultivable Exotic fishes of warm water: Common Carp (Cyprinus carpio), Silver Carp (Hypophthalmichthys molitrix), Bigheaded Carp (Aristichthys nobilis), Grass Carp (Ctenopharyngodon idella), Tilapia (Tilapia niloticus) and Mungri (Clarius gariepinus), Exotic fish of cold water: Rainbow Trout (Oncorhynchus mykiss), Indigenous fishes: Bhakur (Catla catla), Rohu (Labeo rohita) and Mrigal (Cirrhinus mrigala)
 - 9.7.2 Non-cultivable Warm water: Mungri (*Clarius batrachus*), Singhi (*Heteropneutes fossilis*), *Channa, Mystus, Clupisoma*. Cold water: Hill stream fishes- *Tor, Schizothorax and Neoleissocheilus*.
- 9.8 Construction and management of fish ponds
- 9.9 Poly culture, integrated fish culture (paddy cum fish culture, fish with vegetables and fruits, fish with animal husbandry)

10. Economic Zoology

- 10.1 Crop pests and safe storage of food grains
- 10.2 Types of pesticides, use and hazards, and integrated pest management
- 10.3 Bio fertilizers bacteria, cyanobacteria, fungi and earthworm
- 10.4 Poultry farming and animal husbandry- over view & common practices in Nepal
- 10.5 Prawn culture, apiculture & sericulture- over view & common practices in Nepal
- 10.6 Environment and energy recycling- biomass production and utilization of energy; bio- fuel

10.7 Concept of transgenic animals

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| Imit | | | Woight | No. | Spe | ecification |
|------|-------------------------------|---------|--------|-------------|--------------------|-------------------------|
| No. | Contents Title | Section | -age | of items | I - Level (60%) | II & III Level (40%) |
| 1. | Lower Non-chordata | | 10 | 10 | 6 | Λ |
| 2. | Higher Non-chordata | | 10 | 10 | 0 | 4 |
| 3. | Chordata (Poikilotherms) | Α | | | | |
| 4. | Chordata (Homeotherms) | | 15 | 15 | 9 | 6 |
| 5. | Physiology and Biostatistics | | | | | |
| 6 | Cell Biology, Developmental | | | | | |
| 0. | Biology and Genetics | | | | | |
| | Ecology, Wildlife, Evolution, | | 10 | 10 | 6 | 4 |
| 7. | Zoo-geography and Animal | р | | | | |
| | Behavior | В | | - | | |
| 8. | Medical Zoology | | | | | |
| 9. | Fish and Aquaculture | | 15 | 15 | 9 | 6 |
| 10. | Economic Zoology | | | | | |
| | Total | | 50 | 50 | 30 | 20 |

Table of specification

Paper IV: Optional Paper- Sample MCQs of Zoology

I - Level Questions

| 1. | An Obelia is : | | | |
|----|----------------|---------------|--------------|-------------|
| | A) autotroph | B) heterotrph | C) myxotroph | D) holozoic |

2. Euplectella spp. is commonly called :

- A) Glass rope sponge
- B) Venus flower basket
- C) Mermaid's gloves
- D) Boring sponge

3. Red panda, Ailurus fulgens is

- A) A threatened species B) A rare species
- C) A vulnerable species D) An endangered species

4. Identify true and false in following statement.

- 1) Pila globosa has masticatory apparatus called radula.
- 2) The masticatory apparatus of a Sea urchin is Aristotle's lantern.
- A) 1 is correct but 2 is false
- B) 1 is false but 2 is correct
- C) Both statements are correct
- D) Both statements are false

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II & III Level Questions

- 5. DNA molecule contains both purine and pyrimedine bases like
 - a) Adenine b) Thymine c) Cytosine d) Uracil
 - A) a and b
 - nd b
 - B) a and c
 - C) a and d
 - D) b and c

6. Match the common name with their Zoological name.

- 1. Hoplobatrachus tigrinum
- b) Indian bull frog

a) Indian major carp

- 2. Labeo rohita
- 3. Common carp

- A) a-2, b-3
- B) a-2, b-1C) a-3, b-2
- D) a-1, b-2
- 7. Match the followings

| a) Lamprey | | | | | | |
|-----------------|----------|----------|--|--|--|--|
| b) Rana tigrina | | | | | | |
| <i>,</i> | e | | | | | |
| | <u>a</u> | <u>b</u> | | | | |
| A) | 1 | 2 | | | | |
| B) | 1 | 3 | | | | |
| C) | 2 | 3 | | | | |
| D) | 3 | 1 | | | | |

- 1. Ammocoete larva
- 2. Tadpole larva
- 3. Tadpole
- 8. According to Red Data Book and are quoted as endangered mammals of Nepal. Which of the following pair best suit the gaps?
 - A) Red Panda and One Horned Rhinoceros+
 - B) Red Panda and Aarna
 - C) One Horned Rhinoceros and Deer
 - D) Aarna and Deer
- 9. Read the following statements and identify the correct and incorrect alternative
 - 1) Human beings respire both aerobically and anaerobically
 - 2) Respiratory quotient (RQ) of mixed diet is 0.8
 - 3) Tidal volume of man is 550 ml
 - A) All 1, 2 and 3 are correct
 - B) All 1, 2 and 3 are incorrect
 - C) 1 and 2 are correct but 3 is incorrect
 - D) 1 and 3 are correct but 2 is incorrect.

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- 10. Which of the following pair related to function of pond ecosystem is matched.
 - a) Surface feeder
- Benthos
 Zooplankton
- b) Column feederc) Bottom feeder
- 3. Phytoplankton
- 4. Abyssal
- A) a-1, b-2, c-3
- B) a-3, b-2, c-1
- C) a-2, b-1, c-3
- D) a-1, b-3, c-4

11. Match the theories of organic evolution with their postulators.

| a) Darwinism | 1. Lamarck |
|----------------------------|-------------|
| b) Modern synthetic theory | 2. Darwin |
| c) Lamarckism | 3. Stebbins |
| | 4. Weismann |

b C a 2 3 A) 1 2 4 B) 1 3 2 C) 1 4 3 1 D)

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Paper IV: Academic Optional Paper (018) – Chemistry <u>Section A - 30 Marks</u>

1. Physical Chemistry

1.1 **Gaseous state**: kinetic theory of gases, derivation of kinetic gas equation, root mean square velocity, average velocity, most probable velocity, average kinetic energy of gas molecules, Maxwell distribution of speeds, collision diameter, collision frequency, mean free path, deviation of real gas from ideal behaviour, van der Waal's equation, liquefaction of gases

Liquid State: Qualitative treatment of liquids, vapour pressure and boiling point. **Solid state**: Inter-planar distance in cubic system, Brags law and its application, Frenkel and Schottky defects.

Colligative properties: Raoult's law and vapor pressure lowering, elevation of boiling point and depression of freezing point, osmotic pressure, van't Hoff factor, abnormalities in solution due to association and dissociation

1.2 Thermodynamics and thermo-chemistry: Hess's law, molar heat capacity, Kirchoff's equation, calorific value of fuel and food, Joule-Thomson effect, inversion temperature, spontaneous and non-spontaneous changes, second law of thermodynamics, isothermal and adiabatic expansion, Carnot's cycle, entropy and its physical significances, entropy changes of system, surrounding and universe, entropy change in expansion of an ideal gas, entropy of mixing, free energy and its significances, criteria of spontaneity, relation between $\triangle G, \triangle H$ and $\triangle S$, Gibbs-Helmholtz equation

Phase equilibrium: Meaning of the terms: phase, component and degree of freedom, Gibb's phase rule, phase equilibria of one component system, two component system with simple eutectic and incongruent melting point, fractional distillation, azetropes, phenol-water system, lower and upper consolute temperatures, Henry's law.

Surface chemistry and colloids: Physical and chemical adsorption, types of adsorptions, Freundlich isotherm, Langmuir adsorption isotherm, Colloidal state of matter, lyophilic and lyophobic colloids, preparation, purification, and properties of colloids, soap and detergents, zeta potential, electrophoresis, electro-osmosis, precipitation of sol, gold number, Hardy-Schutz law, cleansing action of soap and detergents, emulsion and gel

1.3 **Electrolytic conductance:** Debye-Huckel theory (qualitative treatment only), activity and activity coefficients, ionic strength, Debye-Huckel limiting law (qualitative treatment only), conductivity cell and cell constant, equivalent and molar conductivities, variation of conductance with dilution, Kohlraush's law, ionic mobility, Hittorf's rule, transference number.

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Electrochemical cells: Electrochemical cells, thermodynamic quantities $(\triangle G, \triangle H, \triangle S)$ of cell reaction, liquid junction potential, electrode reaction, single electrode potential, standard hydrogen electrode, reference electrode, cell notation, Nernst's equation.

Chemical kinetics: Order and molecularity of reaction, differential and integrated forms of rate equations, pseudo order reaction, rate determining step, half life, effect of temperature on the reaction rate, activation energy, collision and transition state theories (qualitative treatment only), consecutive, parallel and opposing reactions, chain reaction, kinetics of reaction between hydrogen and bromine

2. Inorganic Chemistry

2.1 **Atomic structure**: Schrödinger's wave equation, physical significance of wave function, probability density pattern for hydrogen atom, radial and angular wave functions, radial distribution curves, shapes of s, p, d orbital, quantum numbers and their significance, energy level diagram

Periodic classification: Introduction to IUPAC system of periodic table, atomic, ionic and covalent radii, ionization potential, shielding effect, electro negativity, different scales of electro negativity measurements (Pauling, Mulliken), electron affinity.

Chemical bonding: Ionic bond: radius ratio, lattice energy, Born equation, Born-Haber cycle, covalent character in ionic compounds, Fajan's rule, structure of ionic compounds (type AX and AX₂), layer structures. **Covalent bond**: valence bond approach, resonance energy, VSEPR theory, hybridization, multiple bonding, three electron bond, two electron three centered bond, bond length and bond order, bond strength, elementary idea of LCAO and concept of united atoms in MO theory, M.O. configurations of simple diatomic molecules and ions

Acids and bases: Hard and soft acids and bases (HSAB), application of HSAB principle, relative strengths of acids and bases and the effect of substituents and solvents on them.

2.2 **Refining and purification of metals:** oxidative refining, parting process, zone refining and Mond's processes for refining, separation and extraction of metals

Chemistry of d-block elements and their compounds: General trends in electronic configurations, ionic and covalent atomic radii, electronegativity, electron affinity, ionization potential, colour and magnetic properties, variable valancy, complex formation with reference to 3d-block elements, introduction of transition series, Werner's theory, ferrocene, nickel carbonyl, isomerism in coordination compounds, VBT, CFT, characterization of complexes, application of complexes in analytical and biological fields

Preparation, properties, bonding and structure of the following: Hydrazine, hydroxylamine, hydrazoic acid, xenon fluorides and oxo-compounds (MO treatment for XeF₂)

2.3 **Chemical fertilizers:-** Nitrogen fixation, nitrogen, phosphrous chemical fertilizers, nitrogenase, synthetic model of nitrogen fixation.

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Organometallic Compounds: General survey of types, preparative route for metalcarbon bond formation, metallocenes, haptonomenclature.

Environmental pollution: Elementary idea of environmental pollution in air and water, primary pollutants, organic and inorganic pollutants, thermal pollutants, sediments, radioactive materials, BOD, COD.

Bio-inorganic chemistry: Roles of metals in biological system, role of Fe in oxygen carrier, essential and trace elements and toxicology.

Inorganic polymers: Homo-polymers and co-polymers, boron nitrides, borazine, organosilicon compounds and silicones, phosphonitrilic compounds, polythiazyls (SN)_x

Section B - 20 Marks

3. Organic Chemistry

3.1 **Structure and Properties:** Hybridization, hydrogen bonding, inductive effect, resonance, mesomeric effect, hyper-conjugation effect, steric effect, IUPAC nomenclature

Stereochemistry: Configuration, absolute configuration (R and S), sequence rules, conformation of n-butane, structural isomerism and stereoisomerism, optical activity, enantiomerism, chiral centre, racemic modification, diastereomers, meso-compounds

Synthesis: Synthesis of alkanes, alkenes and alkynes, alkyl halides, alkanols, alkanals, alkanones, aromatic aldehydes and ketones, aliphatic and aromatic acids and amines, phenols, Wittig reaction, Aldol condensation, dehydration of aldol products, cross-aldol, Claisen, Perkin and Benzoin condensations, Kolbe's reaction, Riemer-Tiemann reaction, Gattermann synthesis, Cope rearrangement, Claisen rearrangement

Bio-organic Chemistry: Biological oxidation-reduction and their stereochemistry, organic chemistry of vision, biosynthesis of fatty acids

3.2 **Reaction Mechanism:** Mechanism, kinetics and stereochemistry of S_N1 , S_N2 , E_1 and E_2 reactions, Hoffmann degradation, mechanism, orientation and reactivity of electrophilic addition, hydrogenation, addition of hydrogen halides, peroxide effect, halohydrin formation, oxymercuration-demercuration, hydroboration-oxidation, hydroxylation, addition to carbon carbon multiple bonds and carbonyl compounds, Michael reaction, Diel's Alder, Mannich and Reformatsky Reactions.

Redox reactions: Baeyer–Villiger oxidation, Oppennaur, lead tetra-acetate, chromic acid, permanganate, peracid and hydroboration oxidations, ozonolysis, Wolf-Kishner, Clemmensen, Birch and Metal hydride reductions, Catalytic hydrogenation.

Active methylene compounds: malonic ester and acetoacetic ester synthesis and their applications, tautomerism (keto-enol), stability, structure, generation and fate of carbocation, carbanion, carbene, nitrene and benzyne, definition of polymer, polypropylene and polyethylene, preparation of Bakelite and uses

Free radicals: Structure, reactivity and selectivity, addition reaction (mechanism and orientation)

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3.3 Aromatic compounds: Stability of benzene, Huckel's rule, aromaticity and antiaromaticity, mechanism of electrophilic substitution (nuclear and side chain), Friedel Craft's alkylation and acylation, theory of reactivity and orientation, effect of substituent groups

Heterocyclic compounds: Structure and reatctivity of pyrrole, furan, thiophene and pyridine, electrophilic and nucleophilic substitutions.

Carbohydrates: Classification, reactions, structure of (+)–glucose, (-)–fructose, stereo-isomers of (+)–glucose, aldose: oxidation, effect of alkali, osazone formation, lengthening and shortening of the carbon chain, conversion of aldose into epimer and into ketose and vice versa

Proteins and Nucleic Acid:- Structure of amino acids, amino acids as dipolar ions, iso-electric point, synthesis and reactions of amino acids, uses in synthesis of peptides

Introduction of Green Chemistry: Basic principle and of green chemistry, green catalyst (phase transfer catalyst)

4. Analytical Chemistry

- **4.1 Principles of qualitative and quantitative analysis:** Theoretical aspects of qualitative and quantitative analysis, principles of gravimetric and volumetric analysis, use of redox, adsorption and metal ion indicator
- **4.2 Simple analytical techniques:** ion exchange chromatography, solvent extraction, conductometric titrations involving neutralization and precipitation reactions, determination of pH using hydrogen, quinhydrone and glass electrodes, potentiometric titrations involving neutralization and precipitation reactions.
- **4.3 Basic Principles of Spectroscopy:** Electromagnetic radiations, effect/ interactions of electromagnetic radiations on atoms and molecules (qualitative), basic principles of ultraviolet and infra-red spectroscopy and application to simple molecules.

| I Init | | | Weight- age | No. | Specification | |
|--------|-----------------------|---------|----------------|-------------|-------------------|---------------------------|
| No. | Contents Title | Section | | of items | I -Level (60%) | II & III - Level (40%) |
| 1. | Physical Chemistry | Α | 15 | 15 | 9 | 6 |
| 2. | Inorganic Chemistry | | 15 | 15 | 9 | 6 |
| 3. | Organic Chemistry | В | 15 | 15 | 9 | 6 |
| 4. | Analytical Chemistry | | 5 | 5 | 3 | 3 |
| | Total | 50 | 50 | 30 | 20 | |

Table of Specification

Paper IV: Optional Paper- Sample MCQs of Chemistry

I - Level Questions

1. Root mean square speed of gas molecules is

| | A) $\sqrt{\frac{2RT}{M}}$ | B) $\sqrt{\frac{6RT}{M}}$ | C) $\sqrt{\frac{8RT}{M}}$ | D) $\sqrt{\frac{3RT}{M}}$ |
|----|--------------------------------------|----------------------------|--------------------------------|---------------------------|
| 2. | In the Mond's process, pu 50^{0} C | ıre nickel is produc Te | ed by the reaction $mp=Y^{0}C$ | |
| | Ni + X | > Ni (CO) ₄ | > Pure Ni | |
| | What do X and Y represe | nt? | - | |
| | A) CO and 230° C | | | |
| | B) $CO + H_2$ and $100^{\circ}C$ | | | |

- C) $CO_2 + H_2$ and $150^{0}C$ D) $CO + H_2$ and $230^{0}C$
- 3. In the extraction of silver by parke's process, the parting of the silver is carried out by using

| A) Fe | B) Pb | C) Zn | D) Cu |
|-------|-------|-------|-------|
| | | | |

4. Eriochorome black-T is an example of
A) Metal-ion indicator
C) Precipitation indicator
D) Acid-base indicator

II & III - Level Questions

5. In the following steps of reaction between hydrogen and bromine:

| Step I | $\mathbf{Br}_2 + \mathbf{Br}_2$ | \rightarrow | $Br_2 + Br_2^*$ |
|----------|---------------------------------|---------------|-----------------|
| Step II | Br_2^* | \rightarrow | $Br^* + Br^*$ |
| Step III | $Br^* + H_2$ | \rightarrow | $HBr + H^*$ |
| Step IV | $H^* + Br_2$ | \rightarrow | $HBr + Br^*$ |
| Step V | H* + HBr | \rightarrow | $H_2 + Br^*$ |
| Step VI | $Br^* + Br^*$ | \rightarrow | Br ₂ |
| | | | |

The chain initiating step is the step and the chain inhibiting step isA) I, VIB) II, VC) III, IVD) II, VI

- 6. $2Na_2S_2O_3+I_2 \rightarrow Na_2S_4O_6+2NaI$
 - a. The above reaction is a reaction for redox titration
 - b. The above reaction is a reaction for Iodometry
 - c. The above reaction is a reaction for Iodimetry
 - d. The above reaction uses adsorption indicator

Which of the above statement is correct?

| A) Only a | B) a and b | C) a,b and c | D) a,b,c and d |
|-----------|------------|--------------|----------------|
|-----------|------------|--------------|----------------|

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- 7. Data required in the Born- Haber cycle for the formation of NaCl are
 - A) Ionization energy of Na (g) , electron affinity of chlorine (g)
 - B) Ionization energy of Na (s), electron affinity of chlorine (g).
 - C) Sublimation energy of Na (s), electronegativity of chlorine (g)
 - D) Sublimation energy of Na (g), electroneagtivity of chlorine (g)
- 8. In the compound,



- A) All B-H bonds are of identical length
- B) The bridging B-H bonds are longer then terminal B-H
- C) The bridging B-H both are shorter than terminal B-H
- D) The bond length cannot be predicted
- 9. The complex ion $[Fe(CN)_6]^{4-}$ is diamagnetic because
 - A) CN^{-} is a strong field ligand and the complex formed is low spin octahedral complex
 - B) CN is a weak field ligand and the complex formed is a high spin octahedral complex
 - C) The central metal ion has paired electrons in its ground state
 - D) The central metal ion has unpaired electrons in its ground state

10. Identify the correct statement:

- i. The relative lowering of vapour pressure is proportional to the mole fraction of a nonvolatile solute
- ii. The relative lowering of vapour pressure is proportional to the mole fraction of the nonvolatile solvent
- iii. The lowering of vapour pressure is proportional to the mole fraction of a volatile solute
- iv. The lowering of vapour pressure is proportional to the mole fraction of a volatile solvent

Among the above statements:

- A) Only i) is correct
- B) Only ii) and iii) are correct
- C) Only i) and ii) are correct
- D) Only ii), iii) and iv) are correct

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- 11. Identify the true and false statements:
 - a. Equivalent conductance of solution of electrolytes increases with increasing dilution.
 - b. Specific conductance of solution of electrolytes increases with increasing dilution.
 - c. The absolute value of the electrode potential of standard hydrogen electrode is zero.
 - A) All a, b and c are true
 - B) All a, b and c are false
 - C) a and c are true and b is false
 - D) a is true and b and c are false

12. Match the following:

| a. Ph | enol-wate | er system | i. (| Cooling c | urves | |
|-------------------|-----------|-----------|----------------------------|-----------------------------|-----------------------|--|
| b. Henry's Law | | | ii. | ii. Vapour pressure diagram | | |
| c. Eutectic point | | | iii. Consolute temperature | | | |
| d. Az | zeotropes | | iv. | . Solubilit | y of gases in liquids | |
| | <u>a</u> | <u>b</u> | <u>c</u> | <u>d</u> | | |
| A) | i | iii | ii | iv | | |
| B) | iii | iv | i | ii | | |
| C) | iv | i | iii | ii | | |
| D) | ii | i | iv | iii | | |

13. Identify True and False statements

- a) p-nitrophenol is more acidic than m -nitrophenol because the deprotonated anion for the para form is able to delocalize the negative charge over the ring and the nitro group.
- b) p-nitrophenol is more acidic than m-nitrophenol because p-nitrophenol forms intramolecular hydrogen bonding whereas m-nitrophenol does not form intra-molecular bonding.
- c) p-nitrophenol is more acidic than m -nitrophenol because it does form inter-molecular hydrogen bonding whereas m- nitrophenol forms intra-molecular bonding.
- A) a) is true, but b) and c) are false
- B) a) is false, but b) and c) are true
- C) all a), b) and c) are true
- D) all a), b) and c) are false

14. Match the following statement

- a) Enantiomers i) stereomers that are not mirror images of each other
- b) Diastereomers ii) stereomers that are mirror images with each other and non super- imposable
- c) Mesoisomers iii) equimolar mixture of two stereomers that are non super- imposable
- d) Racemic Mix. iv) stereoisomer that have plane of symmetry

| | <u>a</u> | <u>b</u> | <u>c</u> | <u>d</u> |
|----|----------|----------|----------|----------|
| A) | i | iii | ii | iv |
| B) | ii | i | iv | iii |
| C) | iii | iv | i | ii |
| D) | iv | iii | ii | i |

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15. Two organic compounds R and S both with molecular formula C₈H₈O gives positive test with 2,4-DNP reagent. Compound R does not reduce Tollen's reagent or Fehling's reagent nor does it decolorize Baeyer's reagent whereas compound S reduces Tollen's reagent or Fehling's reagent but it does not decolorize Baeyer's reagent. On oxidation with chromic acid, compound R gives X (C₇ H₆ O₂) and S gives Y (C₈ H₈ O₂). The compounds R, S ,X and Y are:

| • • • • | | 1 00101 | | |
|---------|--|---|--|--|
| | <u>R</u> | <u>S</u> | <u>X</u> | <u>Y</u> |
| A) | C ₆ H ₅ COCH ₃ | C ₆ H ₅ CH ₂ CHO | C ₆ H ₅ COOH | C ₆ H ₅ CH ₂ COOH |
| B) | p-CH ₃ C ₆ H ₄ CHO | C ₆ H ₄ CH=CHCHO | C ₆ H ₅ CH ₂ COOH | p-CH ₃ C ₆ H ₄ COOH |
| C) | o- CH ₃ C ₆ H ₄ CHO | HOC ₆ H ₄ COCH ₃ | C ₆ H ₄ CH=CHCOOH | C ₆ H ₄ COO CH ₃ |
| D) | C ₆ H ₅ CH ₂ CHO | C ₆ H ₅ COCH ₃ | p-CH ₃ C ₆ H ₄ COOH | C ₆ H ₅ CH ₂ COOH |
| | | | | |

16. Fill up the gap:

Reactions

A compound L (------) that does not react with Baeyer's reagent, on treatment with $KMnO_4$ followed by acidification gives compound M (------) which on treatment with compound Y (-----) followed by treatment with compound Z (------) gives an amide having an empirical formula C₇H₇NO. The compounds L, M, Y and Z are:

| <u>M</u> | <u>Y</u> | <u>Z</u> |
|---|---|---|
| $C_6H_5CO_2H$ | PCl ₅ | Liq.NH ₃ |
| C ₆ H ₅ CH ₂ COOH | HCl | NH ₄ Cl |
| m-CH ₃ C ₆ H ₅ COOH | Cl_2 | NaNH ₂ |
| p- CH ₃ C ₆ H ₅ COOH | NOCl | NaNO ₂ |
| | M C ₆ H ₅ CO ₂ H C ₆ H ₅ CH ₂ COOH m-CH ₃ C ₆ H ₅ COOH p- CH ₃ C ₆ H ₅ COOH | $\begin{array}{c c} \underline{M} & \underline{Y} \\ C_6H_5CO_2H & PCl_5 \\ C_6H_5CH_2COOH & HCl \\ m-CH_3C_6H_5COOH & Cl_2 \\ p-CH_3C_6H_5COOH & NOCl \end{array}$ |

17. Match the following named reactions with the reagents involved:

Reagents

- i. Wittig reaction e). acetic anhydride+ sodium acetate
- ii. Wolff-Kishner reduction f). halogenated acid ester +zinc
- iii. Reformatsky reaction g). Ph₃P=CH₂
- iv. Perkin reaction h). $NH_2 NH_2 + NaOH$

| | i | <u>ii</u> | <u>iii</u> | iv |
|----|---|-----------|------------|----|
| A) | ē | f | g | h |
| B) | f | e | h | g |
| C) | h | g | e | f |
| D) | g | h | f | e |