

लोक सेवा आयोग
नेपाल इन्जिनियरिङ्ग सेवा, सिभिल समूह, इरिगेशन उपसमूहको राजपत्राङ्कित तृतीय श्रेणी पदको खुला र
आन्तरिक प्रतियोगितात्मक लिखित परीक्षाको पाठ्यक्रम

द्वितीय पत्र :- इरिगेशन सम्बन्धी विषय

- 1. IRRIGATION ENGINEERING** **70%**
- 1.1 Introduction (Section 1.1,1.2 and 1.3: 10%)**
- 1.1.1 Definition of irrigation
 - 1.1.2 Function of irrigation and its advantages
 - 1.1.3 Status of irrigation development in Nepal
- 1.2 Soil Moisture and Crop Relationships**
- 1.2.1 General classification of soil for agricultural purposes
 - 1.2.2 Soil moisture/crop-water requirement
 - 1.2.3 Factors affecting crop-water requirements
 - 1.2.4 Crop-water requirement calculation by Penman method
 - 1.2.5 Principal crops, their seasons and their water requirements
- 1.3 Method of Applying Water in Irrigation Fields**
- 1.3.1 Surface, subsurface and sprinkler methods
 - 1.3.2 Techniques of surface irrigation and their suitability
 - 1.3.3 Advantages and disadvantages
- 1.4 Canals** **10%**
- 1.4.1 Classification of canals according to function
 - 1.4.2 Types of permanent and inundation canals
 - 1.4.3 Components of the canal system, major canal, branch canal, distributary and water courses
 - 1.4.4 Canal alignment
 - 1.4.5 Canal losses due to seepage and evaporation
 - 1.4.6 Assessment of water requirement in canals and command area
 - 1.4.7 G.C.A., C.C.A., N.C.A., Duty delta and their relationships
 - 1.4.8 Base period, Kor period and Kor depth
- 1.5 Design of canals** **10%**
- 1.5.1 Use of manning uniform flow equation for canal design
 - 1.5.2 Semi-theoretical approaches of canal design
 - 1.5.3 Design of Stable canal in alluvium
 - 1.5.4 Silt theory of Kennedy and Lacy
 - 1.5.5 Uses of Garrets and other diagrams
 - 1.5.6 Lined canals, various types of lining, advantages and economics of lining
 - 1.5.7 Design of lined canals
 - 1.5.8 Cross-section of canal, berms, banks, roadways and spoil banks
 - 1.5.9 Specific design considerations for hilly irrigation canals
- 1.6 Hydraulic Structures** **10%**
- 1.6.1 Headworks : their types, function and components
 - 1.6.2 Bed sediment control at headworks : silt excluder, slit extractor and their types
 - 1.6.3 Types of cross-drainage structures, conditions of applications and their designs, escapes
 - 1.6.4 Design considerations of canal drop and series of drops, conditions of applications and their designs
 - 1.6.5 Distributary head and other regulation of flow discharges, and their designs

- 1.5.6 Specifics of design considerations for hydraulic structures in plain and hilly regions
- 1.6.7 Considerations for local materials in designs

1.7 Surface and Subsurface Flow Considerations for Design of Hydraulic Structures (Section 1.7 & 1.8: 10%)

- 1.7.1 Definitions, flow past structures
- 1.7.2 Hydraulic jumps
- 1.7.3 Safety against piping and uplift
- 1.7.4 Principles of design for subsurface flow of structures, Khosla's theory

1.8 Water Logging and Drainage

- 1.8.1 Courses and effects of water logging
- 1.8.2 Preventive measures of water logging
- 1.8.3 Surface drainage and drainage of irrigated land
- 1.8.4 Reclamation of water logged areas by different methods
- 1.8.5 Sub-surface irrigation and drainage system, and their combination

1.9 Water Induced Disaster and Mitigation 10%

- 1.9.1 Risk, hazard and vulnerability
- 1.9.2 Landslides and their control
- 1.9.3 River training and its necessity
- 1.9.4 Stages of rivers and their meandering process
- 1.9.5 Methods of river training and design
- 1.9.6 Effects of degradation on the river structures
- 1.9.7 Flood control and its necessity
- 1.9.8 Methods of flood control and design
- 1.9.9 Navigation possibilities in Nepalese rivers

1.10 Planning and Management of Irrigation System (Section 1.10 & 1.11: 10%)

- 1.10.1 General irrigation system planning
- 1.10.2 Organization and irrigation management
- 1.10.3 Development of a small scale irrigation project
- 1.10.4 Operation and maintenance of irrigation systems
- 1.10.5 Institutional aspects of irrigation system management

1.11 Distribution Systems

- 1.11.1 Water management and its control
- 1.11.2 Different types of canal outlets
- 1.11.3 Design considerations

2. ENGINEERING HYDROLOGY

30%

2.1 Physical Hydrology (Section 2.1 & 2.2: 10%)

- 2.1.1 Hydrological cycle
- 2.1.2 Precipitation, its causes, classification and measurement by rain gauges
- 2.1.3 Types of rain gauges and errors in adjustment
- 2.1.4 Double mass curve method of adjustment
- 2.1.5 Analysis of point rainfall by three methods
- 2.1.6 Intensity duration curves
- 2.1.7 Infiltration and percolation
- 2.1.8 Factors affecting infiltration rate

2.2 Surface Runoff

- 2.2.1 Rainfall-runoff correlation and rating curves
- 2.2.2 Stream gauging

- 2.2.3 Stream flow measurement by the velocity area method
- 2.2.4 Current meters, their use and calibration
- 2.2.5 Flow measurement in a river cross-section
- 2.2.6 Velocity measurement by floats
- 2.2.7 Slope area method of computing discharge
- 2.2.8 Discharge measurement by using notches and weirs
- 2.2.9 Factors affecting runoff from catchments
- 2.3 Hydrograph Analysis (Section 2.3 & 2.4: 10%)**
 - 2.3.1 Hydrographs and their analysis
 - 2.3.2 Unit hydrographs and their limitations
 - 2.3.3 Derivation of unit hydrographs from storms
- 2.4 Hydrology of Floods and Low Flows**
 - 2.4.1 Frequency and probability concepts
 - 2.4.2 Frequency analysis and recurrence interval
 - 2.4.3 Gumbel's method in hydrology
 - 2.4.4 Flood prediction and design flood
 - 2.4.5 Peak flow estimation using empirical methods
 - 2.4.6 The rational method and its limitations
 - 2.4.7 Low flow
- 2.5 Ground Water 10%**
 - 2.5.1 Ground water aquifers
 - 2.5.2 Wells and their classification
 - 2.5.3 Well hydraulics
 - 2.5.4 Testing of wells
 - 2.5.5 Recharge of ground water
 - 2.5.6 Role of ground water in irrigation development

द्वितीय पत्रको एकाईहरूको प्रश्नसंख्या निम्नानुसार हुनेछ

द्वितीय पत्रका एकाई	1.1,1.2,1.3	1.4	1.5	1.6	1.7,1.8	1.9	1.10,1.11	2.1,2.2	2.3,2.4	2.5
प्रश्न संख्या	1	1	1	1	1	1	1	1	1	1

विषयगत नमूना प्रश्नहरू (Sample questions)

Irrigation Engineering

1. A trapezoidal channel is 10.0m wide and has a side slope of 1.5 horizontal: 1 vertical. The bed slope is 0.0003. The channel is lined with smooth concrete with Manning's $n=0.012$. Compute the mean velocity and discharge for a depth of flow of 3.0m. Also, for the above channel find the bottom slope necessary to carry only $50.0\text{m}^3/\text{s}$ of the discharge at a depth of 3.0m. {Answers: $V=2.36\text{m/s}$, $Q=102.66\text{m}^3/\text{s}$, $S=0.0000712$ }
2. A trapezoidal channel 5.0m wide and having a side slope of 1.5 horizontal: 1 vertical is laid on a slope of 0.00035. The Manning's roughness coefficient $n=0.015$. Find the normal depth for a discharge of $20.0\text{m}^3/\text{s}$ through this channel. {Answer: $Y_n=1.82\text{m}$ }.

3. Classify the rivers on different basis. What may be the objectives of river training? Brief the different methods of river trainings.
4. Mention different components of Headworks. What may be the effects of construction of a weir on the river regime? What are the causes of its failure on permeable foundation?
5. What is a Cross Drainage Works? Why is it necessary in a canal alignment? Briefly mention the different types of Cross Drainage Works. What are the factors to be taken into account while selecting the suitable type of Cross Drainage Works?
6. What are the factors affecting Crop Water Requirements? Explain the procedure for computing Crop Water Requirements by Pen Man's Equation.
7. Write short notes on:
 1. Afflux
 2. Retrogression
 3. Under sluices
 4. Lacey's waterway

Engineering Hydrology

8. Write short notes on:
 1. Aquifers
 2. Coefficient of Permeability
 3. Darcy's Law
 4. Specific Capacity
9. A 20cm diameter well penetrates an artesian aquifer, 35m thick. Determine the discharge from this well for a drawdown of 2.5m. Assume $K=30\text{m/day}$ and radius of influence=300m. Also determine the percentage increase in the discharge if the diameter of well is made one and half times larger; the other conditions remain the same as given above. {Answers: $Q=82.4\text{m}^3/\text{hr}$, Increase=5.26% }
10. Given below are observed flows from a storm of 6 hour duration on a stream with a catchment area of 500 km^2 . Assuming the base flow to be zero, derive the ordinates of a 6 hour unit hydrograph.

Time (hour)	Observed Flow (m^3/s)
0	0
6	100
12	250
18	200
24	150
30	100
36	70
42	50
48	35
54	25
60	15
66	5
72	0