

1. Fundamentals of Hydrology

1.1 Hydrological principles and measurements: Introduction of Hydrology, Scientific development and Importance of hydrology, Status of Hydrological development and its challenges in Nepal, Components of Hydrologic cycle and hydrologic budget, Application of hydrology in national development, River system of Nepal.

1.2 Precipitation: Measurement standards and techniques, Meteorological aspects, Mean aerial rainfall, Design storm, Intensity Duration Frequency (IDF) curve, Probable Maximum Precipitation (PMP), Depth Area Duration Relationship (DAD) curve, Temporal and spatial variation of precipitation, Storm analysis, Precipitation data sources and interpretation.

1.3 Runoff: Runoff components, Effects of catchment characteristics on runoff, Stream types and Stream flow variability, Rainfall-runoff relations, Stream flow hydrographs (Unit hydrograph, S-curves and IUH) derivation, interpretations and limitations.

1.4 Snow and glacier Hydrology: Snow formation and accumulation, Melting of snowpack, Snowmelt indexes, Snow melt runoff, Snow accumulation, ablation and runoff, Glacier mass balance, Contribution of snow and glaciers on river runoff, Evolution of glacial lakes and glacial lake outburst flood (GOLF).

1.5 Hydrologic Measurements: Precipitation measurements, recording and non-recording precipitation gauges, Precipitation measurements using telemetry, Errors in measuring precipitation data, Snowpack measurements, Snow courses, Radioisotope snow measurements, Determination water equivalent, Discharge measurement, Infiltration measurement, Evaporation and evapotranspiration measurements, Class A pan, Evaporimeters, Lysimeters, Infiltration, measurements of soil moisture, Interception Depression storage, Stream flow measurement standards and technique, Stage measurements, Discharge measurements, Rating curve preparation and applications, Indirect measurements for determination of peak instantaneous discharge, Structural design and river hydraulic considerations, River gauging structure, Hydro-meteorological stations and network design. Various sources of errors and their estimations in hydrologic measurements.

2. Engineering Hydrology

2.1 Applied hydrology and data preparation: Hydrological and meteorological data checking techniques, Precipitation and stream flow estimation in ungauged river basins, Different types of hydrological data and analyses used in water resources, infrastructures development and disaster risk reduction activities, Status of data availability, techniques for estimation of data and their quality assessments, Public Private Partnership (PPP) approach for enrichment of quality and availability of hydrological data, Status and challenges in collection, processing, analyses of

लोक सेवा आयोग
नेपाल इन्जिनियरिङ्ग सेवा, सिभिल समूह, हाइड्रोलोजी उपसमूह, रा.प.प्रथम श्रेणीको पदको खुला र आन्तरिक
प्रतियोगितात्मक परीक्षाको पाठ्यक्रम

- Hydrological- Meteorological data for practical application of Integrated Water Resources Management (IWRM), principle in water resources planning and development.
- 2.2 Sediment:** Sources of Sediment and sediment transport theories for different types of sediment transport in rivers, Sediment measurement techniques, data collection standards, equipment and analyses. Data availability status and their importance, Factors affecting reservoir sedimentation, Control measures for reservoir's sedimentation, Sediment properties, Sediment production, Upland erosion and universal soil loss equations, Sediment Yield, Sediment-delivery ratio, Empirical formulas for sediment yield, Sediment transport, Sediment transport mechanics, Sediment rating curves, Sediment deposition in reservoirs, Reservoir trap efficiency, Reservoir design life.
- 2.3 Water Quality:** Properties of water, Water pollution and its parameters for sustainable development of water resources, Water quality sampling techniques and analyses, Status of water quality data availability, Water quality simulation.
- 2.4 Ground Water Hydrology:** Occurrence of ground water, Ground water flow equation, Movement of ground water and its velocity, Ground water yield, Ground water aquifers and their type, Unconfined, Confined, Semi-confined and Artesian aquifer, Study radial flow towards well in unconfined and semi-confined aquifer, Stream aquifer interaction, Base flow and physiographic characteristics. Ground water monitoring networks and analyses, Recharge of ground water aquifers.
- 3. Hydrological responses and planning**
- 3.1 Flood and Drought analyses:** Derivation of Instantaneous unit hydrograph (IUH) technique, S-hydrograph technique, synthetic unit hydrograph technique, synthetic unit hydrograph for different catchments of Nepal, Rational method, Runoff curve number method, Statistical series and return periods, Adjustment of runoff data, Flood frequency analyses techniques, Base flow estimations, Low flow frequency analysis and drought over Nepal.
- 3.2 Regional analysis of hydrological variables:** Regional distribution of precipitation, hydrology and distribution of runoff, Various regional techniques used for estimation of Flood flows, Low flows, Long terms flows, flow duration curve, the highest and lowest flow, e-flow concept and it's estimation techniques including applications constrains and challenges. Driving factors of hydrological responses and its impacts on urban area, Issues in urban flooding and pollution, Urban hydrology.
- 3.3 Hydrological Tools:** Reservoir and Stream Channel Routing, Muskingum method, Kinematic method. Trans-boundary river and water Managements system and its management.
- 3.4 Engineering economy in water resources planning:** Steps involving in engineering economy, Commonly used parameters used in engineering economics, Economics of

combined water resources, flood control and multipurpose project, Principles of optimization in planning water resources project, Budgeting, Water resources development and planning, project development cycle, Environmental impacts due to water resources and multipurpose project.

4. Hydrological modelling and its application

4.1 Hydrological-Hydraulic modeling and its applications: Different types of hydrologic and hydraulic models, their advantages, limitations and challenges for applications; Classification of hydrological model, Black-box model, Conceptual model, Stochastic model, Lumped model, Semi-distributed and distributed model, Model components and its understanding.

4.2 Computing runoff volume: Basic concept and application of Unit hydrograph (UH) model, user-specified UH, parametric and synthetic UH, Snyder UH model, SCS UH model, Clark UH model, HEC-HMS, HEC-RAS model, MIKE Model, SWAT model, NAM Model, HBV model, J2000 model, TOP Model and BTOPMC model etc., and some application of hydrological model in Nepalese context, Modelling techniques, procedures and their requirements, Uncertainties and interpretations techniques in hydrological and hydraulic simulations, Model calibration and verification, Linear reservoir model and estimating base flow model parameters.

4.3 Project Management: Project development planning and execution considering, Stakeholder requirements, Role of hydrological modelling in Integrated Water Resources Management (IWRM) and execution of basin planning concept of water resources projects.

5. Disaster risk reduction and flow forecasting

5.1 Water Induced disaster and risk reduction: Different types of water induced disaster and their management. Disaster management cycle and key hydro meteorological elements supporting multi-hazard disaster in Nepal. Fundamental problems associated with disasters, Snow avalanches, Glacial lake outburst flood, Flash flood, land slide dammed flood, Bank cutting by river flood, Flood and Inundation,

5.2 Flow Forecasting technique and early warning: Methods of forecasting by different method, dissemination its limitation of flood forecasting, time of concentration, estimation of snow and glacier melt projection, Rainfall- runoff and river level forecast, Forecast formulation and verification forecast, Dissemination of forecast, Lead time, Data assimilations and forecast improvement system, Impact based flood forecasting, Flood hazard and risk assessments, Application of remote sensing and GIS, forecast based financing, Simulation of warning level and danger level, Development of Early warning system in Nepal, International and National standard operating procedures of early warnings, flood forecasting, data sharing and early warnings for transboundary river and water management, International and National disaster risk reduction initiatives. Legal provisions for water induced multi-hazard disasters management.

6. Climate change

6.1 Climate change and its impacts in Hydrology: Impacts of climate change on hydrological processes on global and National level, Impacts of climate change on various components of the Hydrologic Cycle, Impact of climate change on snow and glacier system in Nepal Himalayas, Impact of climate change on rainfall-runoff response in Nepal, Impact of climate change and water balance of Nepalese river basins, Impact of climate change on snowpack and glacier and glacial lakes, Impact of climate change on extreme flows and flow regimes, Impacts of climate change on water quality and quantity. Climate change adaptation and mitigation measures, Climate change studies and scenario simulations.

6.2 Climate change on water resources management in Nepal: Impacts of climate change and its mitigations and adaptations measures on water resources management, Climate change Impact on agriculture, Impact of climate change on hydropower production, irrigation and drinking water supply, Impact of climate change on livelihood and economy in different regions, Organizations involved in climate change study and research activities, IPCC activities and their reports on climate change studies. Application remote sensing techniques on Hydro-Meteorological observation and climate change studies.