# Course summarized Assignment for the course Applied Hydrology
# (Msc program for Hydraulics Engineering)

Q1. Rainfall Analysis

A. Review the different methods for the development of Intensity Duration curve (IDF) and write a brief not for the merit and limitations of the methods ( at least three methods )

B. Consider the following annual maximum daily rainfall data; Estimate the annual maximum 30 minute rainfall intensity with 20 years return period.

| **Year** | **1984** | **1985** | **1986** | **1987** | **1988** | **1989** | **1990** | **1991** | **1992** | **1993** |
|---|---|---|---|---|---|---|---|---|---|---|
| **Depth (mm)** | 82 | 78 | 110 | 89 | 74 | 80 | 86 | 99 | 93 | 76 |

C. Justify your reason for the choice of the method you applied on section B above

Q2. Rainfall-Runoff linear theory

A. Write a brief note on the concept of hydrograph and unit hydrograph and give a brief for three methods of methods and application for unit hydrograph

B. For a given catchment having a catchment and flow characteristics presented below in the table. develop the inflow hydrograph for the reservoir at the outlet of this catchment

| Catchment Characteristics | Dimension | Flow characteristics | $m^3$/sec |
|---|---|---|---|
| Area (km2) | 105.0 | Qp for 100 year Return period | 66.0 |
| Length (km) | 34.0 | Qb for the catchment at dry season | 3.6 |
| Centroid distance (km) | 18.4 | | |
| Slope of catchment (m/m) | 0.0038 | | |

C. If you have an event based rainfall excess and storm hydrograph presented below in the table, Develop the 2hr-UH, and IUH for the catchment

| Time (hr) | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flow (m3/sec) | 1 | 44.5 | 110.5 | 85.5 | 102.8 | 94 | 38.4 | 18.6 | 10.9 | 5.3 | 2.9 | 0.5 |
| ER (cm) | 0.5 | 0.7 | 0.0 | 0.8 | | | | | | | | |

Q3. Flood Routing

A. Write 5 pages an assessment report on the flood routing methods used in HEC-HMS model with their applications and limitations. Give your opinion on the improvement of the limitation

B. The inflow hydrograph you develop in Q2B is an input for the reservoir stage-storage-out flow discharge in the table. Route the computed inflow

C. using the routed outflow and the inflow in Q2B develop the K and X parameters for the channel

| **E(m)** | **100.0** | **100.5** | **101.1** | **101.5** | **102.0** | **102.5** | **102.75** | **103.0** |
|---|---|---|---|---|---|---|---|---|
| S ($10^6$ $m^3$) | 3.350 | 3.472 | 3.880 | 4.383 | 4.882 | 5.370 | 5.5527 | 5.856 |
| Q ($m^3$/s) | 0 | 10 | 26 | 46 | 72 | 100 | 116 | 130 |

Q4. Hydrological statistics

A. Give examples of hydrological variables that can be modeled with a
   - a continuous valued and a discrete-valued
   - random series,
   - lattice process, or continuous-time process, or continuous-space process, or continuous space-time process

B. The covariance of a random function is described by: $C(h) = 10 \exp(-h\ 30/\ )$, and a constant mean. The probability distribution function (PDF) at a given location is the Gamma distribution. Is this process: a) wide sense stationary; b) second order stationary; d) strict stationary? Briefly Justify your choice

C. Write the basic concept and principle of linear uni-variate time series models and give three example models with their question formulation

Q5. Flood Frequency

Consider the following yearly daily maximum daily stream flow data ($m^3$/sec) of a gauging station

| 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1266 | 1492 | 1862 | 861 | 715 | 1367 | 1837 | 1429 | 1429 | 1261 | 1607 | 2132 | 1652 | 1537 | 1155 | 1899 | 1956 |
| 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 |
| 1596 | 1380 | 745 | 2181 | 955 | 1007 | 824 | 1271 | 1044 | 597 | 1216 | 1061 | 1450 | 2016 | 1270 | 1341 | 1075 |
| 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
| 2482 | 874 | 1689 | 1554 | 1831 | 1149 | 1444 | 1791 | 1207 | 3050 | 1578 | 2817 | 792 | 1143 | 1698 | 2076 | 1204 |

A. Fit the data with multi-probability distribution and select the three best fit probability distribution for the data set
B. Determine the parameters of the three best fit probability distributions
C. Plot the quantiel of the stream flow using the three best fit and analysis the similarity and different of the results among the probability distributions
D. Estimate PMF the station

Q6. Time series Analysis

A. Describe the functional form of the simplest AR and ARMA models
B. Why such models are referred to as *autoregressive* or *moving average*
C. State the three steps in ARMA modeling
D. The diagnostic patterns of the autocorrelation and partial autocorrelation functions for an AR(1) time series
E. Write a simple R-code for time series data plotting and statistics computation

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