國立成功大學 107 學年度碩士班招生考試試題

系　所：水利及海洋工程學系

考試科目：水文學

考試日期：0205，節次：3

※ 考生請注意：本試題可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. "How much water does a river need?" is always the question when we consider the ENVIRONMENTAL FLOW (EF). Tennant (1976) said "Philosophically, it is a crime against nature to rob a stream of that last portion of water so vital to the life forms of the aquatic environment that developed there over eons of time" and suggested 30~50% of a river's average flow could possibly provide excellent habitat in the river. If the 20-year daily flow record is available for considering the EF, please answer the following questions:

   (a). In order to provide enough water for water supply purpose, we probably only release 5~10% of a river's average flow for the downstream environmental need. Alternatively, we consider using Q_{95} as the criteria for the environmental need, please explain how to get the Q_{95} from the above data. (10%)

   (b). What is the name of the curve used to get the Q_{95}? Please also provide a short description (a figure is preferred) of the curve. (5%)

   (c). Could you suggest any other hydrological statistic methods (or other methods) to determine EF value, and what are the major reasons you think the methods are suitable for environmental flow? (5%)

2. As a hydrologic engineer, you are responsible for flood hazard mitigation program in Happy Village. According to a historical event, a storm had three successive 6-hr interval of rainfall magnitude of 2.6, 3.1, and 1.6 cm, respectively. Assuming Φ-index is 0.10 cm/hr. In the outlet of this watershed, you found the observed streamflow is as following table.

Time (h)	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
Streamflow (m^3/s)	5	9	19	50	82.5	103	113	98.5	77.5	54	32.5	20.5	12.5	8	6	5	5

   (a). Please determine the 6-hr unit hydrograph. (10%)

   (b). Please estimate the area of this watershed. (5%)

   (c). Now the Central Weather Bureau in Happy Village has a rainfall forecast as following table. The Φ-index and base flow are assumed the same as previous case. Please determine the flood hydrograph for this coming storm. (15%)

Time (hr)	0~3	3~6	6~12	12~18
Rainfall intensity (cm/hr)	1	1.1	0.8	0.7

3. The total area of the developing new town is 10 km^2 which includes 5 km^2 residential area, 3 km^2 business area, and 2 km^2 grass area. It takes 10 minutes from the farthest point of the new town to the inlet of the planed sewerage system. The channel length of the sewerage system is 1,800 m, and the designed flow is 1.0 m/sec. Please use following information and rational method to estimate the peak flow of the outlet of the sewerage system. (15%)

Landuse type	business	forest	grass	industrial	residential
Runoff coeff.	0.82	0.31	0.23	0.85	0.52

$$i\left(\frac{mm}{hr}\right) = \frac{1850}{[t(min) + 19]^{0.7}}$$

4. The relationship among elevation, storage and outflow of a reservoir is tabulated below:

	250.0	250.3	250.6	251.0	251.4	251.8	252.2
Storage (10^6 m^3)	4	4.3	4.7	5.2	5.8	6.5	7.4
Outflow (m^3/s)	0.0	0.0	10.0	24.0	42.0	66.0	96.0

The inflow hydrograph of a reservoir is tabulated below:

Time (hour) t	0	3	6	9	12
Inflow (m^3/s)	10	32	68	50	40

If the reservoir surface is at 250.0 m at the time t = 0, please determine the outflow hydrograph from 0~12 hours. (15%)

5. Dr. Lo collected 50 year maximum hourly rainfall data from a gauge station. The mean of the data is 20 mm/hr, the standard deviation is 6 mm/hr, and the skewness is 0.25. He also calculated the logarithm of the each rainfall data and got the mean (1.3), standard deviation (0.11), and skewness (0.15).

(a). Please use Gumbel (EV1), normal, lognormal, and Pearson Type III distribution to determine the 100 year storm event. (16%)

(b). What is the return period of 30 mm/hr storm event by using Gumbel distribution? (4%)

Skew coefficient C_s or C_w	Return period in years / Exceedence probability						
	2	5	10	25	50	100	200
	0.50	0.20	0.10	0.04	0.02	0.01	0.005
0.5	-0.083	0.808	1.323	1.910	2.311	2.686	3.041
0.4	-0.066	0.816	1.317	1.880	2.261	2.615	2.949
0.3	-0.050	0.824	1.309	1.849	2.211	2.544	2.856
0.2	-0.033	0.830	1.301	1.818	2.159	2.472	2.763
0.1	-0.017	0.836	1.292	1.785	2.107	2.400	2.670
0.0	0	0.842	1.282	1.751	2.054	2.326	2.576