M.E. (Civil) First Semester Examination, 2011

Subject: Hydrologic Design and Analysis (CE-912)

Time: 3 hours | *Answer Question 5 and any three from the rest.* | Full Marks: 70

1. a) The design flood for a particular bridge has a return period of 50 years. What is the probability that any flood greater than or equal to this design flood i) may occur once in next 50 years, ii) twice in next 25 years, iii) at least once in next 50 years. [8]

   b) The annual maximum discharge records at a gauging site of a stream are given below. Find the i) Mean, ii) Median, iii) Standard Deviation and v) Coefficient of variation. [12]

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Discharge (m^3/s)	105	121	125	130	150	135	165	185	124	160	129

2. a) With neat sketches, describe any two methods of base flow separation from a hydrograph. [8]

   b) The following table shows observed annual rainfall and corresponding annual runoff from a small catchment. Develop the rainfall-runoff equation for this catchment and find the correlation coefficient. What runoff can be expected from this catchment for an annual rainfall of 120cm? [12]

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Rainfall (cm)	91	110	40	125	145	102	150	52	120	92	65	76
Runoff (cm)	32	50	26	62	75	40	65	18	45	36	25	20

3. a) A catchment with five raingauge stations (A, B, C, D, E) is shown in Figure 1. During a particular storm, rainfalls recorded by the raingauges are shown in parentheses (in mm). Draw the Thiessen Polygon and estimate the average rainfall over the catchment. If 65% of this rainfall is available as surface runoff, how much volume (Mm^3) of runoff you can expect at the catchment outlet, C ? [12]

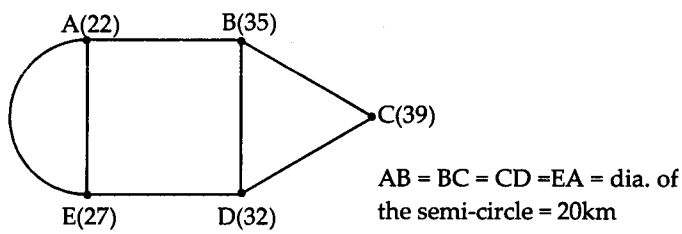

Figure 1. The Catchment Area

   b) Determine the optimum number of raingauge station for the catchment in Fig. 1. From this, determine the percentage error in estimation of mean rainfall for the existing system (i.e., no additional stations are installed). If the additional stations are installed outside the catchment, do the existing Thiessen influence areas change? [8]

4. a) A 7-h storm produced rainfall intensities (in mm/h) of 4, 9, 20, 18, 13, 11, 12, 2, 8, 16, 17, 13, 6 and 1 at 30-min intervals over a basin of area 1830 km^2. If the observed runoff is 36.6 Mm^3, estimate the ϕ-index for the storm. [12]

   b) The Horton's infiltration equation for a basin is given by $f_{ct} = 8 + 30\, e^{-0.8t}$, where fct is in mm/h and t is in hours. What are the fco, fcf and K values? If a storm of uniform intensity 42 mm/h occurs, determine the average rate of infiltration for the first two hours and depth of infiltration for the first one hour, using integration method. [8]

5. a) With neat sketch, define Unit Hydrograph. State the assumptions in the Unit Hydrograph Theory. [6]

   b) Ordinates of the discharge hydrograph at the outlet of a catchment due to a rainfall of 2.8cm for the first 3h and 4.2cm for the next 3h are given below. Derive the ordinates of the 3h unit hydrograph for the catchment. [14]

Time(h)	0	3	6	9	12	15	18	21	24	27	30
Discharge (m^3/s)	0	120	480	660	460	260	160	100	50	20	0

6. a) Ordinates of a 2h UH are given below. Derive the ordinates of a 4-h UH. [8]

Time (h)	0	2	4	6	8	10	12	14	16	18	20	22	24
UH Ordinates (m^3/s)	0	22	60	130	138	119	88	60	40	25	14	5	0

b) Ordinates of a 6-h UH are given below. Derive the ordinates of a 3-h UH. [12]

Time (h)	0	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
UH UH Ordinates (m^3/s)	0	18	42	72	110	142	160	146	122	95	68	45	26	14	7	3	0

7. a) Write a program to estimate evaporation loss using Meyer's formula. [5+5=10]

b) Write a program to estimate the optimum number of raingauge stations for an allowable error (eps%) in the estimation of mean rainfall.