Assignment – Module 5

1. The inflow and demands over a year for a proposed reservoir is as follows

Period, t	1	2	3	4	5	6	7	8	9	10	11	12
Inflow, Q_t	6	12	15	17	13	11	6	4	6	0	0	0
Demand, R_t	5	5	9	2	6	6	10	10	10	9	9	9

   Obtain the reservoir capacity using sequent peak method

2. Using the data in problem no.1, obtain the reservoir capacity using Linear Programming.
3. A reservoir is proposed to supply water at a maximum constant rate per season for a city. The inflows in the six seasons of the year are 5, 20, 12, 5, 3, and 5, respectively. Neglecting all the losses, determine the minimum required reservoir capacity using sequent peak method.
4. The monthly inflows (Q_t) and demands (D_t) in Mm^3 and evaporation rate (e_t) in mm for a reservoir are given below

Period, t	1	2	3	4	5	6	7	8	9	10	11	12
Inflow, Q_t	97	565	477	195	142	62	27	20	15	12	13	25
Demand, D_t	71	175	175	90	38	279	279	246	123	0	0	0
evaporation rate, e_t	318	202	202	209	169	167	137	134	146	201	303	338

   Area corresponding to dead storage level, A_0 = 50.5 Mm^2 and the slope of the area-capacity curve beyond dead storage, a = 0.1205 m^2/m^3

   Using LP, determine the reservoir capacity with the following

   a. storage continuity constraints of equal to type, with demands as lower bounds for releases

b. storage continuity constraints of the greater than type, with demands as lower bounds for releases,

c. storage continuity constraints in the equality form, incorporating demands and spills explicitly, and using mixed integer LP

5. Using the data from problem no. 4, obtain the storage yield function for different values of storage capacity K.

6. The inflows to a proposed reservoir in four seasons of a year are 330, 180, 270, and 110, respectively, and assumed to repeat every year. Neglecting all other losses, the evaporation loss from the reservoir in any season is considered to be 2.5% of the average storage in that season. The reservoir is proposed to supply water at a constant rate per season to a town and the capacity of reservoir is 100 units. Obtain the constant maximum rate of water supply per season using LP.

7. A three-reservoir system in a river basin functions to absorb floods during the wet season (t=1,2,..,5) and to provide irrigation during the dry season (t=6,7,..,12). Reservoirs 1 and 2, and reservoirs 3 and 2, are in series with reservoir 2 being the downstream reservoir in both cases. The three reservoirs together serve an irrigation area in the dry season (t = 6,7,…,12). At the beginning of the period, t=6 all the reservoirs are full and there is no natural inflow to any reservoir during the dry season. Water may be released for irrigation from reservoirs 2 and 3. The irrigation demand during period t is known as Dt (t= 6,7,…,12). Each unit of water released from reservoir i (i=2,3) brings a benefit of Bit in period t (t=6,7…12). Formulate a LP problem to obtain release policy for each reservoir for maximizing the benefits. The capacities of the reservoirs are known. The irrigation releases from the reservoir i (i=2,3) are restricted by the canal capacity Ci.

Assume that the total benefits from flood control upto the beginning of period 6 is a constant, and that no release is necessary from any reservoir to absorb floods.

8. A water resource system consists of 4 reservoirs. Reservoirs 1, 2 and 4 are in series (in that order, with 1 being the upstream most reservoir). Reservoirs 3 and 4 are also in series, 3 being the upstream reservoir. Each of the reservoirs 1,2 and 3 serves its own powerhouse. The release made into the power house subsequently reaches the immediate downstream reservoir. Each unit of power generated brings a benefit of Bt in period t. The power generated at the reservoir i is limited by the plant capacity pi. The storage - elevation relationship for the reservoir i (i=1,2,3) may be assumed to be linear (known). In addition reservoir 4 serves an irrigation area. Each unit of release made for irrigation from reservoir 4 fetches a benefit of Wt in period t. Assuming the inflows and capacities of reservoirs to be known, formulate an optimization model to maximize the benefits from the system. Identify the decision variables in the problem. For a 12-period problem, how many constraints and how many decision variables will result from the formulation?
9. The inflows to a reservoir during the six periods in a year given by, 82, 110, 590, 350, 0, 0. The reservoir has a live capacity of 950 Mm3. The head available for power generation is given by, h = 25 + (S/20), where h is the head in meters, and S is the reservoir storage in Mm3. Whenever possible, a constant release of 165 Mm3 is made from the reservoir during all periods for power generation. Simulate the power generation from the reservoir considering an initial storage of 550 Mm3. Neglecting the losses, consider that the overflows are not available for power generation.
10. Obtain the power generated by overflows in problem no. 9.

11. Two reservoirs are in series, with Reservoir 1 being on the upstream. Reservoir 1 has a capacity of 1312 Mm3 and Reservoir 2 has a capacity of 2963 Mm3. Both reservoirs serve their individual irrigation areas. Assuming that there is a slightly higher weightage of 1.05 attached to the demands from Reservoir 2, formulate and solve a LP problem to maximise the sum of weighted demands from the two reservoirs. The monthly inflows (Mm3) at the two reservoirs are given below:

Period, t	1	2	3	4	5	6	7	8	9	10	11	12
Res. 1	174	1516	1217	442	328	103	63	21	16	7	13	40
Res. 2	135	447	687	460	368	249	163	74	48	50	73	106

40% of release made from Reservoir 1 subsequently joins as return flow to Reservoir 2, in addition to the inflows shown above.