Module 4:

1. Solve the following water user allocation problem to maximize the total returns, using both forward and backward recursion of Dynamic Programming. Water available for allocation is 60 units. It should be allocated in discrete units of 0, 10, 20, …, 60. Returns from the four users for a given allocation are given in the table below.

Allocation	Returns from			
	User 1	User 2	User 3	User 4
0	0	0	-3	1
10	3	4	3	1
20	5	4	5	1
30	6	4	5	7
40	3	4	4	8
50	3	6	2	10
60	3	7	0	10

2. Solve the four seasons reservoir operation problem discussed in the class with the initial storage, S_1=4 units. Compare the release policy with that obtained in the example and mention which is better.
3. Solve the four seasons reservoir operation problem discussed in the class with the storage at the end of the year (i.e., at the end of the last season, t=4) specified as 0 units and with no constraint on the initial storage. (Hint: Note that in backward recursion, while solving for t=4, you must consider only those releases which result in the end of the season storage of 0 units).
4. In a town, it was decided expand its water supply system with an existing capacity of 10 units to the ultimate requirement of 40 units by the end of 15 years from now, in stages of 5 years each. The present worth of cost of expansion at any stage is estimated to be equal to the square of the number of units added at that stage. The capacity requirement is estimated to be 15, 25 and 40 units by the end of 5, 10 and 15 years from now. Determine how many units should be added at each stage for minimum total cost of capacity expansion over 15 year planning horizon. Capacity can be added only in 5 unit increments.

5. Re-solve the three season reservoir operation problem discussed in the class showing all the steps involved by considering discrete values of releases as 10, 15, 20, 25, 30, 35 and 40.