Assignment LPP

1. The production manager of a chemical plant is attempting to devise a shift pattern for his workforce. Each day of every working week is divided into three eight-hour shift periods (00:01-08:00, 08:01-16:00, 16:01-24:00) denoted by night, day and late respectively. The plant must be manned at all times and the minimum number of workers required for each of these shifts over any working week is as below:

	Mon	Tues	Wed	Thur	Fri	Sat	Sun
Night	5	3	2	4	3	2	2
Day	7	8	9	5	7	2	5
Late	9	10	10	7	11	2	2

The union agreement governing acceptable shifts for workers is as follows:

1. Each worker is assigned to work *either* a night shift *or* a day shift *or* a late shift and once a worker has been assigned to a shift they must remain on the same shift every day that they work.
2. Each worker works four consecutive days during any seven day period.

In total there are currently 60 workers.

- Formulate the production manager's problem as a linear program.
- Comment upon the advantages/disadvantages you foresee of formulating and solving this problem as a linear program.

2. A Company produces two products A and B. The sales volume for A is at least 80% of the total sale of both A and B. However, the company cannot sell more than 100 units of A per day. Both products use one raw material, of which the maximum daily availability is 240lb. The usage rates of the raw material are 2lb per unit of A and 4lb per unit of B. The profit units for A and B are $20 and $50, respectively. Determine the optimal product mix for the company.

3. Jack is an aspiring freshman at Ulern University. He realizes that “all work and no pay make Jack a dull boy”. As a result, Jack wants to apportion his available time of about 10 hours a day between work and play. He estimates that play is twice as much fun as work. He also wants to study at least as much as he plays. However, Jack realizes that if he is going to get all his homework assignments done, he cannot play more than 4 hours a day. How should Jack allocate his time to minimize his pleasure from both work and play?

4. An assembly line consisting of three consecutive stations produces two radio models: HiFi-1 and HiFi-2. The following table provides the assembly times for the three workstations.

	Minutes per unit	
Workstation	HiFi-1	HiFi-2
1	6	4
2	5	5
3	4	6

The daily maintenance for stations 1, 2, and 3 consumes 10%, 14% and 12%, respectively, of the maximum 480 minutes available for each station each day. Determine the optimal product mix that will minimize the idle (or unused) times in three workstations.

5. A company manufactures four products (1,2,3,4) on two machines (X and Y). The time (in minutes) to process one unit of each product on each machine is shown below:

		Machine	
		X	Y
Product	1	10	27
	2	12	19
	3	13	33
	4	8	23

The profit per unit for each product (1,2,3,4) is £10, £12, £17 and £8 respectively. Product 1 must be produced on *both* machines X and Y but products 2, 3 and 4 can be produced on either machine.

The factory is very small and this means that floor space is very limited. Only one week's production is stored in 50 square metres of floor space where the floor space taken up by each product is 0.1, 0.15, 0.5 and 0.05 (square metres) for products 1, 2, 3 and 4 respectively.

Customer requirements mean that the amount of product 3 produced should be related to the amount of product 2 produced. Over a week approximately twice as many units of product 2 should be produced as product 3.

Machine X is out of action (for maintenance/because of breakdown) 5% of the time and machine Y 7% of the time.

Assuming a working week 35 hours long formulate the problem of how to manufacture these products as a linear program.

6. An industrial recycling centre uses two scrap aluminum metals, M1 and M2, to produce a special alloy. Scrap M1 contains 6% aluminum, 3% silicon, and 4% carbon. Scrap M2 has 3% aluminum, ^% silicon, and 3% carbon. The costs per ton for scraps M1 and M2 are $100 and $80, respectively. The specifications of the special alloy require that

(1) the aluminum content must be at least 3% and at least 6%,
(2) the silicon content must lie between 3% and 5%, and
(3) the carbon content must be between 3% and 7%.

Determine the optimal mix of the scraps that should be used in producing 1000 tons of the alloy.

7. Really owns 800 acres of undeveloped land on a scenic lake in the heart of the Ozark Mountains. In the past, little or no regulation was imposed upon new developments around the lake. The lake shores are now dotted with vacation homes, and septic tanks, most of them improperly installed, are in extensive use. Over the years, seepage from the septic tanks led to severe water pollution. To curb further degradation of the lake, country officials have approved stringent ordinance applicable to all future developments:

(1) Only single, double, and triple family homes can be constructed, with single family homes accounting for at least 50% of the total,

(2) To limit the number of septic tanks, minimum lot sizes of 2, 3 and 4 acres are required for single, double and triple family homes respectively,
(3) Recreation areas of 1 acre each must be established at the rate of one area per 200 families.
(4) To preserves the ecology of the lake, underground water may not be pumped out for house or garden use. The president of Realco is studying the possibilities of developing the 800 acre property. The new development will include single, double and triple family homes. It is estimated that 15% of the acreage will be allocated to streets and utility easements. really estimates the returns from the different housing units as follows:

Housing unit	Single	Double	Triple
Net return per unit($)	10,000	12,000	15,000

The cost of connecting water service to the area is proportionate to the number of units constructed. However, the country charges a minimum of $ 100,000 for the project. Additionally, the expansion of the water system beyond its present capacity is limited to 200,000 gallons per day during peak periods. The following data summarize the water service connection cost as well as the water consumption, assuming an average size family:

Housing unit	Single	Double	Triple	Recreation
Water service connection cost per unit($)	1000	1200	1400	800
Water consumption per unit (gal/day)	400	600	840	450

Develop an optimal plan for Realco.