BE10-R4: OPERATIONS RESEARCH

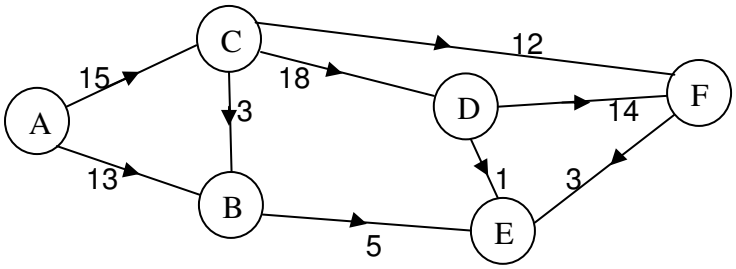
NOTE:

1.	**Answer question 1 and any FOUR from questions 2 to 7.**
2.	**Parts of the same question should be answered together and in the same sequence.**

Time: 3 Hours **Total Marks: 100**

1.

a) Find the critical path for the following network:



b) Write the dual of the following linear programming problem:

Maximize $5x_2 + 2x_3$

subject to $x_1 + 2x_2 \geq 2$

$x_1 - x_2 + 3x_3 = 4$

$x_1, x_2 \geq 0$.

c) Maintenance of machine can be carried out in 5 operations which have to be performed in a sequence. Time taken for each of these operations has a mean time of 5 minutes and follows exponential distribution. The break down of machine follows Poisson distribution and the average rate of break down is 3 per hour. Assume that there is only one machine available, Find out the average idle time for each machine break down.

d) For the function $f(x,y) = 2x^2 - 4xy + 2y^2 - 3x + 4y$, find the steepest descent direction at the point (-1, 2).

e) The production company requires 250 Kg of raw material for manufacturing an item per month. The price of the item is Rs. 50. The cost of placing the order is Rs. 25 and the cost carrying inventory is 10% of the investments in the inventories. Find the economic order quantity.

f) Find the basic feasible solution of the following system with x_1 and x_3 as basic variables.

$2x_1 - x_2 + x_3 = 6$

$-x_1 + 3x_2 + 3x_3 = 4$

g) Solve the following matrix game by locating the saddle points, where the pay off matrix is as follows:

		Player II		
		1	2	3
Player I	1	-2	10	-2
	2	-5	-8	-4
	3	-5	15	-9

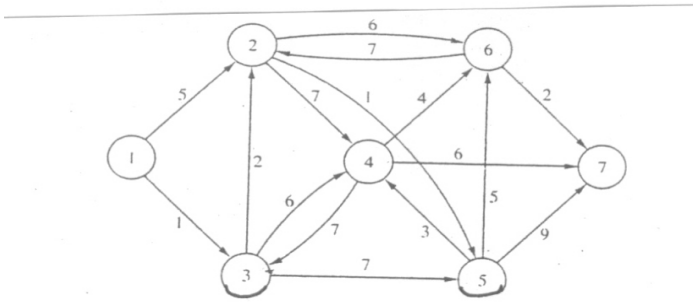
(7x4)

2.

a) Cars are shipped by truck from three distribution centers to five dealers. The shipping cost is based on the mileage between sources and destinations. This cost is independent of whether the truck makes this trip with a partial or full load. The following table summarizes the mileage between the distribution centers and the dealers as well as the monthly supply and demand figures estimated in number of cars. Each truck can carry a maximum of 18 cars. Given that the transportation cost per truck per Km. is Rs.10, formulate the problem as a transportation model Solve and interpret the solution.

	Dealers					
	1	2	3	4	5	**Supply**
1	100	150	200	140	35	400
Distribution2	50	70	60	65	80	200
Centers 3	40	90	100	150	130	150
Demand	100	200	150	160	140	

b) Determine the shortest route node between node 1 and every other node for the network given below:



(9+9)

3.

a) The activities for buying new car are summarized in the following table. Draw the network model and carry out the critical path computations.

Activity	**Description**	**Immediate predecessor(s)**	**Duration in Days**
A	Conduct feasibility study	--	3
B	Find potential customer for present car	A	14
C	List possible models	A	1
D	Research all possible models	C	3
E	Conduct interviews with mechanics	C	1
F	Collect dealer propaganda	C	2
G	Compile and organize all pertinent information	D,E,F	1
H	Choose top three models	G	1
I	Test drive all three choices	H	3
J	Gather warranty and financing information	H	2
K	Purchase one car	I,J	2

b) An automobile dealer wishes to put four repairmen to four different jobs. Though each repairman can perform any job assigned to him, he takes different time to complete the jobs. The estimated number of men-hours that would be required for each job is given below:

		Jobs			
		A	B	C	D
Man	1	8	2	5	3
	2	3	9	7	6
	3	6	4	5	7
	4	5	7	7	8

Find the optimal assignment that will result in minimum time to complete all four jobs.

(9+9)

4.

a) A company uses both its trucks and contractor's truck to distribute goods. It was found that a truck arrives at a loading station on an average in every 10 minutes and it takes about 20 minutes to load it. Assuming that 25% of the trucks are of contractor, compute the following:

i) probability that truck has to wait
ii) waiting time of truck
iii) the expected waiting time of contractor's truck if a total 200 trucks arrived in a day.

b) Consider the following cargo-loading problem, where five items are to be loaded on a vessel. The weight wi and the volume vi per unit of the different items as well as their corresponding values ri are tabulated as follows:

Item i	wi	vi	ri
1	5	1	4
2	8	8	7
3	3	6	6
4	2	5	5
5	7	4	4

The maximum cargo weight and volume are given by W= 112 and V = 109. It is required to determine the most valuable cargo load in discrete units of each item. Formulate the problem as an integer programming model.

(10+8)

5.

a) 7 jobs, each of which has to go through the machines M1 and M2 in the order M2 and M1, the processing time (in hours) are given:

	Jobs						
	A	B	C	D	E	F	G
Machine M1	3	12	15	6	10	11	6
Machine M2	8	10	10	6	12	1	3

Determine the optimum sequence that will minimize the total elapsed time, with idle time of each machine.

b) Consider the problem

maximize $z = x1 + 5x2 + 3x3$

subject to

$x1 + 2x2 + x3 = 3$

$2x1 - x2 = 4$

$x1, x2, x3 >= 0$

Let R be an artificial variable in the second constraint equation. Solve the problem by using x3 and R for a starting basic solution.

(9+9)

6.

a) A manufacturing company purchases 9000 parts of a machine for its annual requirements, ordering one month usage at a time. Each part costs Rs 20. The ordering cost per order is Rs 15 and carrying charges are 15% of the average inventory per year. Suggest a more economical purchasing policy for the company. What advice would you offer and how would it save the company per year?

b) ABC diesel engineering works gets an average 40 engines for overhaul per week. The need of getting diesel engine overhauled is almost constant and the arrival of the repairable engines follows Poisson's distribution . However, the repair or overhaul time is exponentially distributed. An engine not available for use costs Rs 500 per day. There are six working days and the company works for 52 weeks per year. At the moment the company has established the following overhaul facilities.

	Facilities	
	1	2
Installation charges	12,00,000	16,00,000
Operating expenses/year	2,00,000	3,50,000
Economic life (years)	8	10

The facilities scrap value may be assumed to be nil. Determine which facility should be preferred by the company, assuming time value of money is zero?

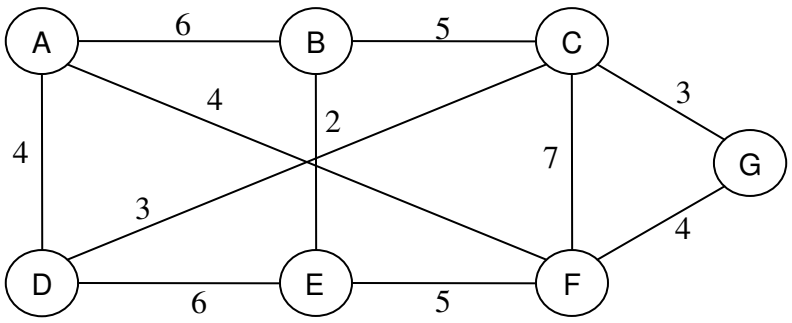
(9+9)

7.

a) Reduce the following matrix game to a 2x2 game by using rule of dominance and modified dominance property and then solve the game.

	B1	B2	B3	B4
A1	1	2	-1	2
A2	3	1	2	3
A3	-1	3	2	1
A4	-2	2	0	-3

b) Use Kruskal's method to find the minimum spanning tree in the following weighted graph:



Explain the steps in detail.

(10+8)