B. PROD. ENGG. 4TH YEAR 1ST SEMESTER SUPPLEMENTARY EXAM. – 2017

OPERATIONS RESEARCH

Time : **Three hours** Full marks: **100**

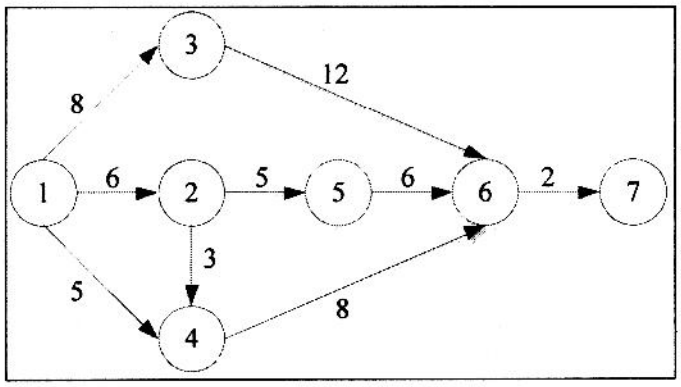
Question No. 1 is compulsory. Answer any four from the rest.

1.(a) ABC company is engaged in manufacturing 5 brands of packed snacks. It is having five manufacturing setups, each capable of manufacturing any of its brands one at a time. The cost to make a brand on these setups varies according to the following table.

	S_1	S_2	S_3	S_4	S_5
B_1	4	6	7	5	11
B_2	7	3	6	9	5
B_3	8	5	4	6	9
B_4	9	12	7	11	10
B_5	7	5	9	8	11

Assuming five setups as S_1, S_2, S_3, S_4 and S_5, and five brands as B_1, B_2, B_3, B_4 and B_5, formulate the corresponding linear programming model for this assignment problem. (10)

(b) Develop the corresponding linear programming model for the following network diagram. (10)



2.(a) State and explain the basic limitations of a linear programming model. (5)

(b) A factory engaged in the manufacturing of pistons, rings and valves for which the profits per unit are Rs. 10, 6 and 4 respectively, wants to decide the most profitable product mix. It takes one hour of preparatory work, ten hours of machining and two hours of packing and allied formalities for a piston. Corresponding requirements for rings and valves are 1, 4 and 2, and 1, 5 and 6 hours respectively. The total number of hours available for preparatory work, machining, and packing and allied formalities are 100, 600 and 300 respectively. Determine the most profitable product mix, assuming that what all produced can be sold. (15)

3.(a) With suitable model, differentiate between transportation and transshipment problems. (5)

(b) Given:
Minimize $Z = 12x_{11} + 8x_{12} + 2x_{13} + 9x_{21} + 10x_{22} + 9x_{23} + 7x_{31} + 15x_{32} + 6x_{33}$ (15)

Subject to supply constraints:
$x_{11} + x_{12} + x_{13} = 40$
$x_{21} + x_{22} + x_{23} = 30$
$x_{31} + x_{32} + x_{33} = 30$

Demand constraints:

$x_{11} + x_{21} + x_{31} = 20$

$x_{12} + x_{22} + x_{32} = 50$

$x_{13} + x_{23} + x_{33} = 30$

$x_{ij} \geq 0$ for i = 1,2,3; j = 1,2,3

Formulate the above transportation problem and solve it using Vogel's Approximation method.

4.(a) Solve the following game problem: (10)

A's strategy	B's strategy			
	b_1	b_2	b_3	b_4
a_1	8	5	-7	9
a_2	-6	6	4	-2

(b) Distinguish between pure and mixed strategies for a game problem. (4)

(c) In a game of matching coins with two players, suppose A wins one unit of value when there are two heads; wins nothing when there are two tails and loses ½ unit when there is one head and one tail. Determine the pay-off matrix and the optimal strategies for both the players. (6)

5.(a) Enumerate the procedural steps of Monte Carlo simulation. (5)

(b) The ABC Scientific Laboratories is engaged in producing different types of high class equipment for use in science laboratories. The company has two different assembly lines to produce its most popular product XYZ. The processing time for each of the assembly lines is regarded as a random variable and is described by the following probability distributions: (15)

Processing time (minutes)	Assembly A_1	Assembly A_2
10	0.10	0.20
11	0.15	0.40
12	0.40	0.20
13	0.25	0.15
14	0.10	0.05

Using the following random numbers, generate data on the process times for 15 units of the item and determine the expected processing time for the product. For this purpose, read the vertically taking the first two digits for the processing time on assembly A_1 and the last two digits for processing time on assembly A_2.

9309	3602	8343
3424	4134	1915
5415	7428	0880
9445	1183	7505
4943	7476	0089

6.(a) A manufacturer of toys makes two types of toys, A and B. Processing of these two toys is done on two machines X and Y. Toy A requires two hours on machine X and six hours on machine Y. Toy B requires four hours on machine X and five hours on machine Y. There are 16 hours of time per day available on machine X and 30 hours on machine Y. The profit obtained on selling these two types of toys is Rs. 3 and Rs. 7 respectively. What should be the daily production of each of the two toys? (A non-integer solution for this problem will not be accepted). (14)

(b) A foreign bank is considering opening a drive-in window for customer service, Management estimates that customers will arrive for service at the rate of 12 per hour. The teller, whom it is considering to staff the window, can serve customers at the rate of one every three minutes. Assuming Poisson arrivals and exponential service, determine (i) average number of customers in the system, (ii) average waiting time in the line, and (iii) average waiting time in the system. (6)

7.(a) Formulate the dual of the following primal linear programming problem: (6)

Maximize $Z = 2x_1 + 3x_2 + x_3 + 4x_4 + 2x_5$

Subject to constraints:

$x_1 + 2x_2 + 2x_3 + 3x_4 + x_5 \leq 10$

$2x_1 + x_2 + 3x_3 + 2x_4 + x_5 \leq 20$

$2x_1 + x_2 + 3x_3 + 2x_4 + x_5$

$x_i \geq 0$ for $i = 1,2,\ldots,5$

(b) State and describe Kendell's notation in queuing theory. (4)

(c) On January 1 (this year), Bakery A had 40% of its local market share while the other two bakeries B and C had 40% and 20% respectively of the market share. Based on a study by a marketing research firm, the following facts were compiled. Bakery A retains 90% of its customers while gaining 5% of competitor B's customers and 10% of C's customers. Bakery B retains 85% of its customers while gaining 5% of A's customers and 7% of C's customers. Bakery C retains 83% of its customers and gains 5% of A's customers and 10% of B's customers. What will each firm's share be on January 1 next year, and what will each firm's market share be at equilibrium? Also draw the corresponding Markov chain model. (10)