B. PROD. E. 3RD YEAR 1ST SEMESTER SUPPLEMENTARY EXAMINATION 2017

OPERATIONS RESEARCH

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

Answer any five questions

1.(a) State and explain the basic assumptions of a linear programming model.   (5)

(b) A company is producing two types of LPG stoves, i.e. Supreme and Cook'n Grill. The material and labour requirements in respect of these and the total availability of these resources in the next month are as given in the following table: (15)

Item	Supreme	Cook'n Grill	Total availability
Material A	2 kg/unit	2.5 kg/unit	2,000 kg
Material B	2 pieces/unit	3 pieces/unit	2,4000 pieces
Labour Grade-I	3 hours/unit	5 hours/unit	6,000 hours
Labour Grade-II	1 hour/unit	1.5 hours/unit	900 hours

Further, according to the present conditions, the company earns Rs. 40 on the sale of one unit of Supreme and Rs. 60 on the sale of one unit of Cook'n Grill. The company wants to decide about the number of units that it should produce next month so that it can earn the maximum profit. Keeping in mind this objective, determine the optimal product mix.

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

(b) Solve the following transportation problem using Vogel's Approximation method.   (15)

From	To				Supply
	1	2	3	4	
1	8	8	5	12	7
2	6	9	11	9	7
3	10	15	6	13	10
4	6	8	7	8	6
5	11	10	11	13	5
6	8	14	5	12	6
Demand	9	12	8	14	

3.(a) Two competitors are competing for the similar product. The pay-off matrix in terms of their advertising plan is shown below: (10)

		Competitor B		
		Large advt.	Medium advt.	Small advt.
Competitor A	Large advt.	70	80	50
	Medium advt.	90	60	95
	Small advt.	105	90	65

Find the optimal strategies and the value of the game.

(b) Customers for a local bakery arrive randomly following a Poisson distribution. The single salesman can attend customers at an average of 12 customers per hour, the service time being distributed exponentially. The mean arrival rate of the customers is 20 per hour. Now, determine the following:
(i) the mean number of customers in the bakery,   (10)
(ii) the mean time spent by a customer in the bakery,
(iii) the expected number of customers waiting to be served, and
(iv) the mean waiting time of atypical customer in the queue.

4.(a) An exporter of ready-made garments makes two types of shirts X and Y. He makes a profit of Rs. 10 and Rs. 40 per shirt on X and Y respectively. He has two tailors, A and B at his disposal to stitch these shirts. Tailors A and B can devote at the most 7 hours and 15 hours per day respectively.

Both these shirts are to be stitched by both the tailors. Tailor A and Tailor B spend 2 hours and 5 hours respectively in stitching an X shirt, and 4 hours and 3 hours respectively in stitching a Y shirt. How many shirts of both types should be stitched in order to maximize daily profit? (a non-integer solution for this problem will not be accepted. (14)

(b) Classify a queuing system according to (i) service system and (ii) queue structure. (6)

5.(a) There are three firms ABC, PQR and XYZ sharing a market as 40%, 40% and 20% respectively on January 1, 2013. Over the years, the following developments took place:
ABC retains 80% of its customers, loses 16% to PQR and 4% to XYZ
PQR retains 84% of its customers, loses 12% to ABC and 4% to XYZ
XYZ retains 76% of its customers, loses 18% to ABC and 6% to PQR.
Assuming the market does not change, (a) what share of the market shall be held by each firm on January, 2015? (b) What would be the long run shares of the forms at equilibrium if the buying habits do not change? (10)

(b) XYZ 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	2	4	7	5	9
B_2	4	3	6	4	5
B_3	3	5	4	6	8
B_4	7	13	7	12	10
B_5	8	5	9	7	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)

6. A manufacturing plant has a large number of similar machines. The machines breakdown randomly and the breakdowns are independent of each other. Once a machine breaksdown, it has to be taken out of production till the time it is repaired. On the basis of the past data, the following distributions have been constructed.

No. of breakdowns per hour	Probability	No. of hours required for repair per breakdown	Probability
0	0.700	1	0.100
1	0.150	2	0.240
2	0.100	3	0.450
3	0.030	4	0.165
4	0.020	5	0.040
		6	0.005

Each hour that a machine remains idle due to being, or waiting to be repaired, its costs the plant Rs. 150 per hour by way of lost production. If a repairman is paid Rs. 50 per hour, how many repairmen should be hired by the company to service the machine breakdowns? For this purpose, simulate the system for a 24-hour period and use the following random numbers, reading row-wise starting with the NW corner. (20)

For breakdowns							
22	75	08	99	66	31	85	63
73	18	11	98	56	22	09	45
42	32	87	69	48	04	54	67
For repair times							
76	19	34	62	78	12	22	55