Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

VI SEMESTER B.TECH (OPEN ELECTIVE -II)
END SEMESTER EXAMINATION, MAY. 2018
SUBJECT: INTRODUCTION TO OPERATIONS RESEARCH (MME 3288)
REVISED CREDIT SYSTEM

Time: 3 Hours   MAX. MARKS: 50

Instructions to Candidates:
❖ Answer **ALL** the questions.
❖ Missing data if any may be suitable assumed.

1A. A store requires following monthly quantities of 3 products.

Product	A	B	C
No. required	16	24	15

The store has received quotations from 4 wholesalers who are able to supply not more than the quantities (of all products combined) below.

Wholesaler	1	2	3	4
Max. supply	24	8	23	5

The store estimates that its cost per product will vary with the product and wholesaler as shown in the following table.   **(05)**

Product		A	B	C
	1	20	15	13
Wholesaler	2	19	12	21
	3	17	13	18
	4	22	12	18

i) How should the orders be optimally placed? What is the total optimum cost per month?

ii. Total supplies from wholesaler 2 and 3 are fixed but the amounts obtained from 1 and 4 can be varied (for the same overall total). How this flexibility could be best employed.

1B. What are the assumptions made in a linear programming problem? Explain.   **(05)**

2A. Solve the given LPP using Simplex method

Maximise $Z = 10X_1 + 9X_2 + 9X_3$

Subject to the constraints   **(05)**

$$X_1 + 3X_2 + X_3 \le 290$$
$$2X_1 + X_2 + X_3 \le 370$$
$$3X_1 + 2X_2 + X_3 \le 400$$
$$X_1, X_2, X_3 \ge 0$$

2B. Solve the following game.

Company 'B' Strategy

		B_1	B_2	B_3	B_4
	A_1	2	-2	4	1
Company 'A'	A_2	6	1	12	3
Strategy	A_3	-3	2	0	6
	A_4	2	-3	7	1

(05)

3A. A company has 4 plants P_1, P_2, P_3 & P_4. Three new products A, B and C are introduced by the company. Any plant can produce any product. The unit production and distribution costs are shown below:

	Unit production costs			
	P_1	P_2	P_3	P_4
A	20	24	21	35
B	12	28	40	25
C	21	17	30	22

	Unit distribution costs			
	P_1	P_2	P_3	P_4
A	12	6	13	3
B	14	6	8	10
C	17	8	12	18

The estimated sales and prices of the 3 products are as follows:

(05)

Product	Sale (No. of units)	Selling Price (Rs/unit)
A	800	50
B	1000	60
C	400	70

Using the above information,
a) State which plant must produce which product so that the total profit is maximized.
b) What is the maximum profit attainable?
c) Should the company use all the plants? Justify.

3B. List and explain the different types of floats identified during a network analysis. (05)

4A. Obtain the dual of the LPP given below.

Max $Z = 7X_1 + 5X_2 - 2X_3$

Subject to the constraints:

$X_1 + X_2 + 3X_3 = 10$

$2X_1 - X_2 + 3X_3 \leq 16$

$3X_1 + X_2 - 2X_3 \geq 11$

$X_1, X_2 \geq 0;$ X_3 unrestricted

(05)

4B. Following are the various activities involved in a project. The cost and time for these activities is given below.

Activity	(i, j)	Predecessor	Time estimates (days)		Direct cost estimates × (Rs 1000)	
			Normal	Crash	Normal	Crash
A	(1,2)	-	16	8	200	440
B	(1,3)	-	14	9	100	180
C	(2,4)	A	8	6	50	70
D	(2,5)	A	5	4	60	130
E	(3,5)	B	4	2	150	300
F	(3,6)	B	6	4	80	160
G	(4,6)	C	10	7	300	450
H	(5,6)	D, E	15	10	500	800

(05)

a) Draw the CPM network
b) Find out the critical path and project completion time.
c) What is the minimum possible project completion time after crashing the activities involved in the project and the associated cost of completing the project?

5A. Conduct the sensitivity analysis for changes in the objective function coefficients and right hand side values of constraints for the given LPP.

Maximize $Z = 30X_1 + 25X_2$

Subject to constraints, $\quad X_1 + 2X_2 \leq 185$

$$3X_1 + X_2 \leq 150$$

$$3X_1 + X_2 \leq 170$$

$$X_1, X_2 \geq 0;$$

Optimal table obtained by the simplex algorithm for maximization LPP is given below.

(03)

Basis		X_1	X_2	S_1	S_2	S_3	b_i
X_2	25	0	1	3/5	-1/5	0	81
X_1	30	1	0	-1/5	2/5	0	23
S_3	0	0	0	0	-1	1	20
C_j		30	25	0	0	0	
Solution		23	81	0	0	20	
Δ_j		0	0	-9	-7	0	

5B. What are the unique characteristics of an assignment matrix? **(02)**

5C. Customers arriving at a counter in the post office are randomly distributed. They are served by the clerk as per their requirements and hence service time is also random. A study of 100 arrivals gave the following inter-arrival time frequency distribution and service distribution.

Inter arrival time (min)	Frequency	Service time (min)	Frequency
2	50	1	10
4	30	2	30
6	10	3	30
8	10	4	20
-	-	5	10

(05)

Simulate the queue for first 10 arrivals and compute the following
  (i)   Proportion of time the clerk is idle.
  (ii) The average waiting time of the customer.

Use the following set of random numbers taken from the pool of 00-99, taking first 10 numbers for arrival time and the remaining for service time.
06 96 64 49 49 24 55 60 73 33   56 76 42 22 06 12 99 57 79 81