[This question paper contains 6 printed pages.]

5184-P *Your Roll No.....*

B.Sc. Prog./Sem. I **B**

MATHEMATICAL SCIENCES

Paper ORC-1 : Operational Research Concurrent – II

(Admissions of 2011 and onwards)

Time : 3 Hours *Maximum Marks : 75*

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt any **five** *questions.*

1. (a) Describe the branch and bound method for the solution of integer programming problem. (7)

(b) A salesman is planning to tour cities B, C, D and E starting from his home city A. The intercity distances are shown in the following table :

City	A	B	C	D	E
A	–	103	188	136	38
B	103	–	262	176	52
C	188	262	–	85	275
D	136	176	85	–	162
E	38	52	275	162	–

P.T.O.

How should he plan his tour so that (i) he visits each of the cities only once and (ii) travels the minimum distance. (8)

2. Solve the following IPP

Maximize $Z = x_1 + x_2$

subject to the constraints

$$3x_1 + 2x_2 \leq 5$$

$$x_2 \leq 2$$

$x_1, x_2 \geq 0$ and x_1 is an integer. (15)

3. (a) Consider the problem of assigning five operators to five machines with the following assignment cost matrix

		Machines				
		I	II	III	IV	V
Operators	A	10	5	13	15	16
	B	3	9	18	3	6
	C	10	7	2	2	2
	D	5	11	9	7	12
	E	7	9	10	4	12

What are the operator-machine pairs that shall minimize the cost? (7)

(b) The following table gives the cost of transporting material from supply points A, B, C and D to demand points E, F, G, H and I.

		To				
		E	F	G	H	I
	A	8	10	12	17	15
From	B	15	13	18	11	9
	C	14	20	6	10	13
	D	13	19	7	5	12

The present allocation is as follows :

A to E 90; A to F 10; B to F 150; C to F 10; C to G 50; C to I 120; D to H 210; D to I 70.

Check if this allocation is optimum. If not, find an optimum schedule. **(8)**

4. (a) Distinguish between PERT and CPM. What is a critical path ? Why is it so important in scheduling and controlling large projects ? Can a critical path change during the course of a project ?

(2+1+2+1=6)

(b) A small project is composed of 7 activities, whose time estimates are listed in the table below. Activities are identified by their beginning (i) and ending (j) node numbers.

Activity (i–j)	Estimated Duration (weeks)		
	Optimistic	Most likely	Pessimistic
1 – 2	1	1	7
1 – 3	1	4	7
1 – 4	2	2	8
2 – 5	1	1	1
3 – 5	2	5	14
4 – 6	2	5	8
5 – 6	3	6	15

(i) Draw the network diagram of the activities in the project. (3)

(ii) Find the expected duration and variance for each activity. What is the expected project length ? (3)

(iii) Calculate the variance and standard deviation of the project length. (2)

(iv) Identify the critical path(s) of the project. (1)

5. The following is a table showing details of a project :

Activity	Immediate Predecessor	Normal		Crash	
		Time (weeks)	Cost (Rs' 000)	Time (weeks)	Cost (Rs' 000)
A	–	10	20	7	30
B	–	8	15	6	20
C	B	5	8	4	14
D	B	6	11	4	15
E	B	8	9	5	15
F	E	5	5	4	8
G	A,D,C	12	3	8	4

The indirect is Rs. 400/day. Find the optimum duration and associated minimum project cost. (15)

6. (a) Define a queueing system. Give example of queueing systems with customer-server machanism, one each for :

(i) both are human beings

(ii) only one is human being and

(iii) none is a human being (3+3)

(b) In a railway marshalling yard, goods trains arrive at the rate of 30 trains per day. Assuming that the inter-arrival time follows an exponential distribution and service time distribution is also exponential with an average of 36 minutes, calculate

(i) the mean queue size and

(ii) the probability that the queue size exceeds 10. (4+5)

7. Derive the steady state distribution of the number of units in the system for a generalized birth-death queueing model. (15)