

## PG (NEW) CBCS

M.Sc. Semester-III Examination, 2019

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

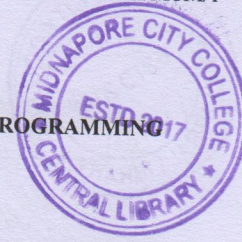
PAPER: MTM-306B

Special Paper

(OPERATIONAL RESEARCH MODELLING-I)

Full Marks: 40

Time: 2 Hours

1. Answer any four questions of the following:

4×2=8

- i) Describe the basic principle of dynamic programming problem method.
- ii) What do you mean by simulation?
- iii) What do you mean by the term "Lead time" and "Procurement cost" in inventory control?
- iv) What are Gradual failure and Sudden failure?
- v) What do you mean by the time-cost relationship in project management?
- vi) Explain the 'individual' and 'group' replacement policies.
- vii) Explain 'Stage' and 'State' in dynamic programming method.
- viii) What are differences between PERT and CPM?

2. Answer any four questions of the following:

4×4=16

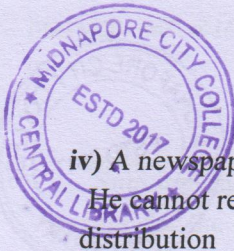
- i) Find the value of  $z = \text{maximize}(y_1 y_2 y_3)$  sub to.  $y_1 + y_2 + y_3 = 5$ ;  $y_1, y_2, y_3 \geq 0$  using dynamic programming problem.
- ii) Write a short note on Monte-Carlo method of simulation.
- iii) A truck owner from his past experience estimates that the maintenance cost per year of a truck whose purchase price is Rs. 150000 and the resale value of truck will be as follows:

Year	1	2	3	4	5	6	7	8
Maintenance (Rs.) $M(t)$	10000	50000	20000	25000	30000	40000	45000	50000
Resale Value (Rs.) $S(t)$	130000	120000	115000	105000	90000	75000	60000	50000

Determine at which time it is profitable to replace the truck.

(Turn over)

(2)



- iv) A newspaper boy buys papers for Rs. 1.40 each and sells them for Rs. 2.00. He cannot return the unsold newspapers. Daily demand has the following distribution

Number Of customers	23	24	25	26	27	28	29	30	31	32
Probability	0.01	0.03	0.06	0.10	0.20	0.25	0.15	0.10	0.05	0.05

In each day's demand is independent of previous day's demand, how many Papers should be ordered each day?

- v) Write down the advantages and disadvantages of simulation procedure.
- vi) Describe dynamic programming method to solve the following problem:  
 $minimize z = \sum_{j=1}^n f_j(y_j)$  sub. to  $\sum_{j=1}^n a_j y_j \geq b$ ,  $a_j$  &  $b$  are real numbers  
 $a_j \geq 0, y_j \geq 0, b > 0, j = 1, 2, \dots, n$
- vii) What are the situations when we use the replacement theory? Discuss the different types of sudden failure. 2+2
- viii) Write down the demerits of CPM. What do you mean by pessimistic, optimistic and most likely times in a network? Explain. 2+2

3. Answer any two questions of the following: 2×8=16

- i) The normal and crash duration with cost for various activities involved in a repair work is given below. The direct cost for supervision of the work is also indicated.

(Turn over)

(3)

Activity	Time(days)		Cost(Rs.)		Expediting Cost/(day) (Rs.)
	Normal	Crash	Normal	Crash	
1-2	6	2	4000	12000	2000
1-3	8	3	3000	6000	600
2-4	7	4	2800	4000	400
3-4	12	8	9000	11000	500
4-6	3	1	10000	13000	1500
5-6	5	2	4900	7000	700
3-5	7	3	1800	5000	800
5-7	11	5	6600	12000	900
6-7	10	6	4000	8400	1100
Total			46100	78400	

The indirect cost of the project is Rs. 2000 per day

- Draw a network diagram for these activities indicating the earliest start and latest finishing time at each time.
  - What is the normal and ultimate Crash duration of the project?
  - Considering the effect of direct and indirect cost, find the optimum project cost for a duration of 10 days.
- ii) Solve the following problem using dynamic programming
- $Maximize z = y_1^2 + y_2^2 + y_3^2 \text{ sub. to } y_1 y_2 y_3 \leq 4,$
- Where  $y_1, y_2, y_3$  are positive integers.*
- iii) Dr. Strong is a dentist who schedules all his patients for 30 min appointments. Some of the patients take more or less than 30 min depending on the type of dental work to be done. The following summary shows the various categories of work, their probabilities and the time actually needed to complete the work

Category	Time Required	Probability of Category
Filling	45 min	0.40
Crown	60 min	0.15
Cleaning	15 min	0.15
Extraction	45 min	0.10
Check-up	15 min	0.20

(Turn over)

(4)

Simulate the dentist's clinic for 4 hours and determine the average waiting time for the patients as well as the idleness of the doctor. Assume that all the patients show up at the clinic at exactly their scheduled arrival time starting at 8:00 A.M.

Use the following set of random number for simulation:

40 82 11 34 25 66 17 79.

- iv) A truck-owner finds from his past experience that the maintenance costs are Rs. 200 for the first year and then increase by Rs. 2000 every year. The cost of the truck type A is Rs. 9000. Determine the best age at which to replace the truck. If the optimum replacement is followed what will be the average yearly cost of owning and operating the truck? Truck type B costs Rs. 20000. Annual operating costs are Rs. 400 for the first year and increase by Rs. 800 every year. The truck owner has now the truck type A which is one year old. Should it be replaced by B type, and if so, when?

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