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End Semester Examination of Semester–III, 2015
Subject : MATHEMATICS (PG)
Paper : MTM–306 (IIB, Special paper)
Full Marks : 40
Time : 2 Hrs

The figures in the margin indicate the marks corresponding to the question.

Candidates are requested to give their answers in their own word as far as practicable.

Illustrate the answers wherever necessary.

Group A

Answer **any two** out of four questions : 10X2=20

1. Derive the differential-difference equation for the queueing system (M / M / 1 : N / FcFs). 8+2

2. a) At time zero, all items in a system are new. Each item has a probability p of failing immediately before the end of the first month of life, and a probability q = 1 – p of failing immediately before the end of the second month. If all items are replaced as they fail, then show that the expected number of failures f(x) at the end of month x is given by

$$f(x)=\frac{N}{1+q}\left[1-(-q)^{x+1}\right]$$

Where N is the number of items in the system.

b) If the cost per item of individual replacement is C_1 and the cost per item of group replacement is C_2, find the condition under which a group replacement policy at the end of each month is the most profitable.

8+2

3. a) Write down the computational procedure for solving on optimization problem by Dynamic Programming technique.

b) A man is engaged in buying and selling identical items. He operates from a warehouse that can hold 500 items. In each month, he can buy as much as he wishes for delivery at the end of the month so long as his stock does not exceed 500 items. For the next four months, he has the following forecasts of purchase costs and selling prices.

Month	1	2	3	4
Purchase cost	27	24	26	28
Selling price	28	25	25	27

If he has a current stock of 200 units what quantities should he sell and buy in next four months? Find the solution using dynamic programming technique.

3+7

4. a) Discuss total float, free float and independent float of an activity in a project.

b) The following table shows activities, their normal time and cost; crash time and cost for a project.

Activity	*Normal time (days)*	*Normal cost (Rs.)*	*Crash time (days)*	*Crash cost (Rs.)*
1–2	6	1400	4	1900
1–3	8	2000	5	2800
2–3	4	1100	2	1500
2–4	3	800	2	1400
3–4	Dummy	—	—	—
3–5	6	900	3	1600
4–6	10	2500	6	3500
5–6	3	500	2	800

Indirect cost for the project is Rs 300 per day.

i) Draw the network of the project.

ii) What are the normal duration and the associated cost of the project?

iii) Find the optimum duration and minimum project cost. 3+7

Group B

Answer **any two** out of four questions : 6X2=12

5. A shop produces three items in lots. The demand rate for each item is constant and deterministic. No back orders are allowed. The pertinent data for the items are given below.

Item	*I*	*II*	*III*
Carrying cost (Rs)	20	20	20
Set-up cost (Rs.)	50	40	60
Cost per unit (Rs)	6	7	5
Yearly demand rate (units)	10,000	12,000	7,500

Determine approximately the economic order quantities for three items subject to the conditions that the total value of average inventory levels of these items does not exceed Rs 1000.00

6. In a car washing service facility, information gathered indicates that cars arrive for service according to a Poisson distribution with mean 5 per hour, the time for washing and cleaning each car varies but is found to follow an exponential distribution with mean 10 min per car. The facility can not handle more than one car at time and has a total of 5 parking spaces (in addition to the servicing car). If the parking space is full, newly arriving car balk away to seek service elsewhere.

   i) Find the average number of cards in the system.

   ii) How many cars balk away in a day (assuming 8 working hours per day) 3+3

7. A small project consists of seven activities, the details of which are given below :

Activity	Immediate Predecessor	Duration (in days) Optimistic	Most likely	Pessimistic
A	—	1	3	7
B	A	2	6	14
C	A	3	3	3
D	B, C	4	10	22
E	B	3	7	15
F	D, E	2	5	14
G	D	4	4	4

i) Draw the network. Find the critical path and the expected project completion time.

ii) What project duration will have 95% confidence of completion? 6

8. a) What are the advantages and limitations of simulation?

b) Discuss different steps involved in Monte-Carlo simulation. 3+3

Group C

Answer **any four** out of eight questions : 2X4=8

9. Explain Transient and Steady states with respect to Queuein & system.

10. What are the differences between PERT and CPM?

11. Using Dynamic Programming, find the value of Max. $z = y_1 \cdot y_2$ subject to $y_1 + y_2 = 5$, $y_1, y_2 \geq 0$.

12. Write the "Basic Axioms" for Poisson queues.

13. What do you understand by "News-boy" problem in Inventory Control System? Explain it.

14. What is Monte-Carlo simulation? Why is it called so?

15. What do you mean by fuzzy inventory model?

16. In a project management, what do you mean by time-cost-trade off? Define cost slope of an activity?