## ASSIGNMENT SET – I

**Mathematics: Semester-III**

**M.Sc (CBCS)**

**Department of Mathematics**

**Mugberia Gangadhar Mahavidyalaya**

## PAPER - MTM-306

### Special Paper: Operational Research Modelling –I

**Answer all the questions**

1. Explain traffic intensity related to queueing model.
2. What are the differences between CPM and PERT
3. What are the benefits of inventory control?
4. What are the differences between analog and computer simulation?
5. Explain with examples the group replacement and individual replacement.
6. Write brief notes on setup cost and lead time in connection with inventory control.
7. Explain with examples the group replacement and individual replacement.
8. What are the limitations of simulation?
9. What is critical path? What are the main features of it?
10. What do you mean by time-cost trade off?
11. What do you mean by supply chain management (SCM)? What is the main Objective of SCM?
12. What is the Limitations of simulation?
13. What is the basic idea of dynamic programming ?
14. Explain the team's 'optimistic time' and 'most likely time' in PERT network.
15. What is Bellman's principle of optimality?
16. State Mortality theorem related to replacement management.

17. Derive the conditions that determine the optimal period of replacing an item whose maintenance cost is increase with time (discrete quantity) but money value is unchanged.
18. A project consists of eight activities with the following relevant information.

| **Activity** | **Time estimates(days)** | | | **Predecessor** |
|---|---|---|---|---|
| | $t_0$ | $t_m$ | $t_p$ | |
| **A** | **1** | **1** | **7** | **None** |
| **B** | **2** | **4** | **7** | **None** |
| **C** | **2** | **2** | **8** | **None** |
| **D** | **1** | **1** | **1** | **A** |
| **E** | **2** | **5** | **14** | **B** |
| **F** | **2** | **5** | **8** | **C** |
| **G** | **3** | **6** | **15** | **D, E** |
| **H** | **1** | **2** | **3** | **F, G** |

19. Describe the kind of problems for which the Monte Carlo will be an appropriate method of solution.
20. The cost of a new machine is Rs.5000.00. The maintenance cost of nth year is given by $c(n) = 500(n-1); n = 1,2,3$ .... suppose that the discount rate per year is 0.05, after how many years will it be economical to replace the machine by a new one ?
21. Find the sequence that minimizes the total elapsed time required to complete the following tasks

| Tasks | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| Time of machine –I | 2 | 5 | 4 | 9 | 6 | 8 | 7 | 5 | 4 |
| Time of machine-II | 6 | 8 | 7 | 4 | 3 | 9 | 3 | 8 | 11 |

22. A newspaper-boy buys papers for rs. 1.70 each and sells them for rs. 2.00 each. He can not return unsold newpapers. Daily demand has the following distribution;

| No. 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 |

23. A team of software developers at Microsoft is planned to rise to a strength of 50 persons and then to remains at that level. Consider the following data:

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total % who have left upto the end of the year | 5 | 30 | 50 | 60 | 70 | 75 | 80 | 85 | 90 | 100 |

On the basis of above information, determine

i) What is the recruitment per year necessary to maintain the strength?

ii) There are 8 senior post's for which the length of service is the main criterion, what is the average length of service after which a new entrant can expect his promotion to one of these post.

24. Draw the network and find the expected project completion time.

25. If the duration for activity F increases to 14 days what will be its effect on this expected project.

26.

27. What are the differences between analog and computer simulation?

28. A bakery keeps stock of a popular brand of cake Previous experience shows the daily demand pattern for the item with associated probabilities as given below:

| Daily demand | 0 | 10 | 20 | 30 | 40 | 50 |
|---|---|---|---|---|---|---|
| Probability | 0.01 | 0.20 | 0.15 | 0.50 | 0.12 | 0.02 |

Random number: 40,19,87,83,73,84,29,09,02,20: use the following sequence of random numbers to simulate the demand for next 10 days.

29. A project consists of eight activities with the following relevant information.

| **Activity** | **Time estimates(days)** | | | **Predecessor** |
|---|---|---|---|---|
| | $t_0$ | $t_m$ | $t_p$ | |
| **A** | **1** | **1** | **7** | **None** |
| **B** | **2** | **4** | **7** | **None** |
| **C** | **2** | **2** | **8** | **None** |
| **D** | **1** | **1** | **1** | **A** |
| **E** | **2** | **5** | **14** | **B** |
| **F** | **2** | **5** | **8** | **C** |
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| **H** | **1** | **2** | **3** | **F, G** |

| | | |
|---|---|---|
| | | |

(i) Draw the network and find the expected project completion time.
(ii) If the duration for activity F increases to 14 days what will be its effect on this expected project.

30. A shopkeeper has a uniform demand of an item at the rate of 50 item per month. He buys from supplier at a cost of Rs. 6 per item and the cost of ordering in Rs .10 each item. If the stock –holding cost are 20% per year of stock value ,how frequently should be replenish his stock?

Now suppose the supplier offers a 5% discount on the order between 200 and 999 items and a 10% discount on order exceeding or equal to 1000. Can the shopkeeper reduce his costs by taking advantage of either of these discounts?

31. Derive the differential difference equation for (M/M/C: N/FCFS/∞) queueing system in transient stage.

32. Solve the following LPP by dynamic programming method

Maximize z=$8x_1 + 7x_2$

subject to the constraints, $2x_1 + x_2 \leq 8$

$5x_1 + 2x_2 \leq 15$ and $x_1 , x_2 \geq 0$

33. What do you meant by random number? Explain a method to generate random number. Use Monte Carlo simulation method find the area of circle whose radius is '$a$'.

34. Suppose in a system all items are new at beginning. Each item has a probability $p$ of failing immediately before the end of the first month of life and probability $q(= 1 - p)$ of failing immediately before the end of the second month. If all items are as they fail. Show that the expected number of failure $f(x)$ at the end of month is given by $f(x) = \frac{N}{1+q}[1 - (-q)^{x+1}]$ where $N$ be the initial items of the system.

If the cost per item of individual replacement policy is Rs. $C_1$ and the cost per item of group replacement policy is Rs. $C_2$. Find the condition

under which group replacement policy at the end of the first month is most profitable over individual replacement.

35. A shopkeeper has a uniform demand of an item at the rate of 50 item per month. He buys from supplier at a cost of Rs.6 per item and the cost of ordering in Rs.10 each item. If the stock –holding cost are 20% per year of stock value, how frequently should be replenish his stock?

Now suppose the supplier offers a 5% discount on the order between 200 and 999 items and a 10% discount on order exceeding or equal to 1000. Can the shopkeeper reduce his costs by taking advantage of either of these discounts?

36. What do you meant by random number?
37. Write a Algorithm Monte Carlo Simulation. Use Monte Carlo simulation method find the area of circle whose radius is '$a$'.
38. Suppose in a system all items are new at beginning. Each item has a probability $p$ of failing immediately before the end of the first month of life and probability $q(=1-p)$ of failing immediately before the end of the second month. If all items are as they fail. Show that the expected number of failure $f(x)$ at the end of month is given by $f(x)=\frac{N}{1+q}[1-(-q)^{x+1}]$ where $N$ be the initial items of the system.

If the cost per item of individual replacement policy is Rs. $C_1$ and the cost per item of group replacement policy is Rs. $C_2$. Find the condition under which group replacement policy at the end of the first month is most profitable over individual replacement.

39. Derive the condition that the optimal period of replacing an item whose maintenance cost is increase with time (discrete quantity) but money value is unchanged.
40. Write the steps to solve the following problem using dynamic programming technique maximize$= f_1(x_1).f_2(x_2)\ldots\ldots\ldots f_n(x_n)$Subject to $a_1x_1+a_2x_2+\cdots+a_nx_n = b;\ a_j, x_{j,}\ b\geq 0\ for\ j=1,2\ldots n$
41. Write brief notes on setup cost and lead time in connection with inventory control.
42. What is basis idea of dynamic programming?
43. A project consists of eight activities with the following relevant information.

| **Activity** | **Time estimates(days)** $t_0$ $t_m$ $t_p$ | **Predecessor** |
|---|---|---|

| | | | | |
|---|---|---|---|---|
| **A** | **1** | **1** | **7** | **None** |
| **B** | **2** | **4** | **7** | **None** |
| **C** | **2** | **2** | **8** | **None** |
| **D** | **1** | **1** | **1** | **A** |
| **E** | **2** | **5** | **14** | **B** |
| **F** | **2** | **5** | **8** | **C** |
| **G** | **3** | **6** | **15** | **D, E** |
| **H** | **1** | **2** | **3** | **F, G** |

(a) Draw the network and find the expected project completion time.

(b) If the duration for activity F increases to 14 days what will be its effect on this expected project.

(ii) What do you mean by supply chain management (SCM)?

(iii) State Mortality theorem related to replacement management.

44. Find the values of $y_1, y_2, y_3$ to

Minimize z = ${y_1}^2 + {y_2}^2 + {y_3}^2$

Subject to $y_1 + y_2 + y_3 \geq 15$ , $y_1, y_2, y_3 \geq 0$

45. (i) What are the differences between CPM and PERT?

(ii) What is cost slope?(iii) Write main features of the critical path.(iv) Determination of floats and slack times.

End