

# Indian Statistical Institute Bangalore

## Statistical Quality Control & Operation Research Unit

MS (QMS) First Year [Batch 2023-2024]

Second Semester – Operation Research-II

Exam: Midterm

Date: 22<sup>nd</sup> February 2024

Maximum Marks: 40

Duration: 2 hours

*Figure in the right hand margin indicates full marks for the questions  
(Answer three full questions, Question-2 & 3 are compulsory)*

- 1 A tax consulting firm has 4 service counters in its office for receiving people who have problems and complaints about their income, wealth and sales taxes. Arrivals average 80 persons in an 8-hour service day. Each tax adviser spends an irregular amount of time servicing the arrivals, which have been found to have an exponential distribution. The average service time is 20 minutes. Determine the followings: **10**
- the average number of customers in the system.
  - the average number of customers waiting to be serviced.
  - the average time a customer spends in the system.
  - the average waiting time for a customer.
  - How many hours each week does a tax adviser spend performing his job?
  - What is the probability that a customer has to wait before he gets service?
  - What is the expected number of idle tax advisers at any specified time?

**OR**

- A maintenance service facility has Poisson arrival rates, negative exponential service times, and operates on a first-come, first-served queue discipline. Breakdowns occur on an average of three (03) per day, with a range of 0 to 8. The maintenance crew can service, on an average, six (06) machines per day, with a range from 0 to 7. Determine the followings: **10**
- utilization factor of the service facility
  - mean waiting time in the system
  - mean number machines in the system
  - mean waiting time of machines in the queue
  - probability of finding 2 machines in the system

- 2 a) A small project involves 7 activities, and their time estimates are listed in the following table. Activities are identified by their beginning (*i*) and ending (*j*) node numbers. **10**

Activity ( <i>i-j</i> )	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

- Draw the network diagram of the activities in the project.
- Find the expected duration and variance for each activity. What is the expected project length?
- Calculate the variance and standard deviation of the project length. What is probability that the project will be completed:
  - at least 4 weeks earlier than expected time.
  - no more than 4 weeks later than expected time.

- b) Explain the following terms in brief and their uses in the network. **5**
- i) Total float,
  - ii) Free float
  - iii) Independent float.
- 3** a) The owner of a readymade garments store sells two types of shirts – Zee-shirts and Button-down shirts. He makes a profit of Rs. 3 and Rs. 12 per shirt on Zee-shirts and Button-down shirts, respectively. He has two tailors, A and B, at his disposal, for stitching the shirts. Tailors A and B can devote at the most 7 hours and 15 hours per day, respectively. Both these shirts are to be stitched by both the tailors. Tailors A and B spend 2 hours and 5 hours, respectively in stitching one Zee-shirt, and 4 hours and 3 hours, respectively on stitching a Button-down shirt. How many shirts of both types should be stitched in order to maximize the daily profit?. Formulate and solve this problem as an ILP problem using the cutting plane method. **10**
- b) Discuss the advantages of the branch and bound method. **5**

-----*Best off Luck*-----