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Your Roll No. ....

235

**B.Sc. (Prog.)/II**

**C**

**OPERATIONAL RESEARCH**

**Paper OR-202 –Inventory Management and Queueing Theory**

**(Admissions of 2005 and onwards)**

*Time : 3 Hours*

*Maximum Marks : 112*

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

Attempt *five* questions in all, selecting at least

*two* questions from each Section.

Simple calculators are allowed.

**Section A**

**(Inventory Management)**

1. (a) Differentiate between deterministic and probabilistic inventory system and discuss in detail the various types of costs associated with the inventory system.

P.T.O.

- (h) A chemical company holds its inventory of raw material in special container with each container occupying 10 square feet of floor space. There is only 5,000 square feet of storage space. Each year this company uses 9,000 special containers of raw material, paying Rs. 8 per container of raw material. If ordering cost is Rs. 40 per order and annual holding cost is 20% of average inventory value, how much is it worth for the company to increase its container of raw material storage area. How many days (maximum) supply of inventory can be stored with 5,000 square feet storage limitation assuming that this company works 300 days a year.
- 12.10
2. Formulate and solve mathematical models for both discrete and continuous, deterministic demand inventory systems. When supply is instantaneous, shortages are not allowed and lead time is zero. Also identify the condition when discrete case will lead to continuous model. Also find reorder level when lead time is finite ( $\tau > 0$ ).
- 22½

3. (a) Discuss any general production scheduling model in detail.
- (b) Discuss a mathematical inventory model for "all unit" quantity discount when shortages are not allowed.

A manufacturing concern requires 2000 units of a material per year. Ordering cost is Rs. 10 per order while inventory carrying cost is Re 0.16 per year per unit of average inventory, the purchase price is Re 1 per unit. Find the economic order quantity and the total inventory cost. If a discount of 5% is available for orders of 1000 units or more but less than 2000 units, should the manufacturer accept the offer. Also if her purchases a single lot of 2000 units or more, he has to pay 0.93 per unit, what purchase quantity you recommend ?

10<sup>15</sup>.12

P.T.O.

4. (a) Formulate and solve a continuous demand time independent, single period stochastic inventory model. A baking company sell one of its cake by weight. It makes a profit of Rs. 9.50 on every kg of cake sold on the day if is baked. It disposes off all cakes not sold on the date at a loss of Rs. 1.5 per kg. If demand is known to be rectangular between 300 and 400 kg, determine the optimal amount baked.
- (b) Discuss the basics of selective inventory control and name various selection techniques adopted in inventory control system. Explain ABC approach in detail. 12½,10

### Section B

#### (Queuing Theory)

5. (a) If arrivals are random then show that the number of arrivals in a fixed time interval follows Poisson distribution and inter-arrival time follows exponential distribution.

- (b) Consider a single server deterministic queuing system with first come and first serve queue discipline. If  $\lambda > \mu$ , where  $\lambda$  and  $\mu$  are mean arrival rate and service rate respectively then obtain  $n(t)$ , the number of customers present in the system and  $W_q$ , the average waiting time of customer in the queue. 12,10½
6. (a) Discuss a generalized birth and death queuing model and obtain the steady state probability distribution of number of units in the system. Discuss also the case :
- (i) Queue with discouragement
- (ii) Ample server system.
- (b) A road transport company has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservation. Customers arrive at a rate of 8 per

hour and the clerk can service 12 customers on an average per hour. Answer the following :

- (i) What is the average no. of customers waiting for the service of clerk ?
- (ii) What is the average time a customer has to wait before getting service ?
- (iii) The management is contemplating to install a computer system to handle the information and reservation. This is expected to reduce the service time from 5 to 3 minutes. The additional cost of having the new system works out to be Rs. 50 per day. If the cost of goodwill of having to wait is estimated to be 12 paise per minute spent waiting before being served. Should the company install the computer system ? Assume 8 hours working day.

7. (a) Derive the expression of steady state probability distribution for the number of customer present in the system for (M/M/C/K/FCFS) queuing model. Also obtain average number of customers present in the queue under steady state.
- (b) Write down the steady state difference equations for (M/M/1) queuing system with finite population size  $m$  and first come, first serve queue discipline. 15.7½
8. (a) Obtain mean, variance and cumulative distribution function for Erlang K distribution.
- (b) Obtain the steady state probability generating function of no. of stages in the system for (M/E<sub>K</sub>/1/∞/FCFS) queuing model. 10.12½