[This question paper contains 5 printed pages.]

3846 *Your Roll No. .....*

B.Sc. Prog./II **IS**

OPERATIONAL RESEARCH

OR–202 – Inventory Management and Queuing Theory

(NC – Admissions of 2005 & onwards)

Time : 3 Hours *Maximum Marks : 112*

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

Answer **Five** *questions in all, selecting at least* **two** *questions from each section.*

SECTION A

(Inventory Management)

1. (a) Why do organizations keep inventory ? Explain the various costs associated with an inventory system.

   (b) Derive "Wilson's Economic Lot Size" formula when lead time is zero.

   Also find reorder level when lead time is τ (>0). What will happen if order quantity Q is deviated from optimal level Q^* ? Discuss.

P.T.O.

A Company uses 10,000 units per year of an item. The purchase price is Re. 1/- per item. Ordering Cost is Rs 25/- per order, carrying cost per year is 12% of the inventory value. Find EOQ, number of orders per year. If the lead time is 4 weeks and assuming 50 working weeks per year, find recorder point. (10,13)

2. (a) Derive a deterministic, discrete demand inventory model without shortages and obtain a decision rule for finding optimal order quantity.

(b) Develop a continuous, deterministic demand multi-item inventory model by taking a restriction on the number of orders placed per year. Shortages are not allowed and production rate is infinite. Also outline the procedure for determining optimal order quantity. (11,11)

3. (a) Differentiate between "all-unit" and "incremental" quantity discount.

Develop and solve a continuous, deterministic demand inventory model by taking "all-unit" quantity discount into consideration. Shortages are not allowed and production rate is infinite.

(b) An Ice-cream company sells one of its type of Ice-cream by weight. If the product is not sold on the day it is prepared, if can be sold at a loss of

Rs. 2/- per pound. But there is unlimited market for one-day old Ice-cream. On the other hand, the company makes a profit of Rs. 5/- on every pound of Ice-cream sold on the day if is prepared. Past daily orders form a distribution as

$$f(x) = 0.02 - 0.0002\,x \qquad 0 \leq x \leq 100$$

How many pounds of Ice-cream should the company prepare every day. (15,7)

4. (a) Discuss any production scheduling model in an inventory system.

(b) From the following details, draw a plan of ABC selective control.

Item	Units	Unit Cost (in Rs.)
1	7000	5
2	24000	3
3	1500	10
4	600	2
5	38000	1.5
6	40,000	0.5
7	60,000	0.2
8	3000	3.5
9	300	8
10	29000	0.4
11	11500	7.10
12	4100	6.2

(10,12)

P.T.O.

SECTION B
(Queueing Theory)

5. (a) Define –

(i) Traffic intensity

(ii) Transient state and steady state

(iii) Single and multiple channel queueing systems

What are the various measures of effectiveness in a queueing system ?

(b) If number of arrivals in a fixed time interval follows Poisson distribution, then show that the interarrival time follows exponential distribution. Also prove that the exponential distribution follows Markovian property and it is the only distribution which follows this property. (11,12)

6. (a) Obtain the steady state probability distribution of number of customers in the system for a generalised birth-and-death (M/M/1 : ∞/FcFs) queueing model. Discuss also the cases (i) queue with discouragement (ii) ample server system.

(b) On an average 96 patients per 24 hour day require the service of an emergency clinic. Also on an average, a patient require 10 minutes of an active attention. Assume that a facility can handle only one emergency at a time. Suppose that it costs the clinic Rs. 100/- per patient treated to obtain an average servicing time of 10 minutes and that each minute of decrease in this average time would cost Rs. 10/- per patient treated. How much would have to be budgeted by the clinic to decrease the average size of queue from $1^1/_3$ patients to $^1/_2$ a patient. (15,7)

7. (a) Derive steady state difference equations for (M/M/C/K/FeFs) queueing system.

(b) Discuss (D/D/1 : ∞/FeFs) queueing model in detail. (8,14)

8. (a) Derive Erlang-K distribution by phase method. Find its mean and variance.

(b) Obtain steady state probability distribution of the number of phases in the system for ($M/E_K/1$: ∞/FeFs) queueing model. (8,14)