Automated Storage and Retrieval System

1. What are the principles of material handling system?
2. What is meant by an automated storage and retrieval system?
3. Describe the following type of storage and retrieval system:
   (a) Unit load AS/RS
   (B) Mini load AS/RS
4. What are advantages of AS/RS over other material- handling system?
5. Four aisles AS/RS is to contain 60 storage compartments in length and 12
   compartments vertically and x = 42” y = 48” the height of a unit load z = 36” find (a)
   capacity of AS/RS.
   (b) Length, breadth and height of AS/RS.
6. Discuss the following issued involved in the system design of an AS/RS.
   (a) Determining load sizes
   (b) Determining utilization of S/R machine.
7. Explain the function of storage system.
8. What are the applications of AS/RS system?
9. What are the components of AS/RS? Explain the following terms.
   (a) Storage space  (b) Storage structure
10. Suppose the single command cycle system for the S/R machine is recommended. The
    average cycle time per operation is 1 min. The desired system throughput is 360
    operations per hour. An operation refers to either storage or retrieval and both take
    approximately the same time. Determine the number of S/R machines.
11. Explain the Deep- Lane AS/RS.

Suggested Brief Answers:

Answer1. Guidelines for designing and operating material-handling system referred to as
principles of material handling system.
   a) Orientation principle. Study the system relationships thoroughly prior to
   preliminary planning in order to identify existing method and problem,
   physical and economic constraint, and to establish future requirement and
   goal.
   b) System principle. Integrate the handling and storage activities that are
   economically viable in to a coordinate system of operations including
   receiving, inspection, storage, production, assembly, packaging etc.
Answer2. An automated storage and retrieval system is defined as “A combination of
equipment and controls which handles stores and retrieves materials with
precisions, accuracy and speed under a defined degree of automation”. In
general AS/RS performs a basic set of operations without human
intervention, regardless of the specific type of system that is employed. These
operations are
   Automatic removal of an item from storage location
   Transportation of this item to a specific processing point
   Automatic storage of an item in a predetermined location, having received
   an item from a processing or interface point.
Answer 3. **(a) Unit load AS/RS:** The unit load AS/RS is used to store and retrieve loads that are palletized or stored in standard size containers. The loads are generally over 500 lb per unit. In general, the unit load system is computer controlled; having automated S/R machine is guided by rails in the floor. Usually, a mechanical clamp mechanism on the S/R machine handled the load.

**(b) Mini load AS/RS:** A Mini load system is designed to handle small loads such as individual parts, tools, and supplies. The system is suitable for use where there is a limit on the amount of space that can be utilized and where the volume is too low for a full scale unit load system and too high for manual system.

Answer 4. Following are the advantages of AS/RS over the material handling system

- Increased storage capacity to meet long range plan.
- Improved inventory management and control.
- Quick response time to locate, store, and retrieve items.
- Reduced shortages of inventory items due to real-time information and control.
- Reduced labour cost due to automation.
- Improved stock rotation.
- Improved security and reduced pilferage because of closed storage area.

Answer 5. (a) The storage capacity

\[
\text{Capacity per aisle} = 2(60)(12) = 1440 \text{ unit loads}
\]

(b) The width length and height of the AS/RS

\[
W = 3(42+6) = 144 \text{ in} = 12 \text{ ft/aisle}
\]

- Overall width = 4(12) = 48 ft
- L = 60(48+8) = 3360 in = 280 ft
- H = 12(36+10) = 552 in = 46 ft

Answer 6. (a) Determining load size: The variety and volume of part types and the type of production system used essentially determine the overall work flow, that is the movement frequency of part, tools, fixtures, pallets, and other supplies. The work flow information is required to determine load size, which is the most important element in the design of an AS/RS. The load size refers to depth, width, and height.

(b) Determining utilizations of AS/RS machine: The S/R machine is most critical component of storage system. Therefore the percentage utilization of S/R machine is an interesting statistic for the performance evaluation of an automated storage and retrieval system. Suppose the system throughput (ST) for an AS/RS is known and each aisles is served by one S/R machine and there are N S/R machine. Then the number of transaction per hour is:

\[
T = \frac{\text{ST}}{N}
\]

Answer 7. Receiving, identification and sorting, dispatching to storage, placing in storage, storage, retrieving from storage, order accumulation, packing, shipping and record keeping for raw material, purchased part, work in
process, finished product, pallets, fixtures, tool, spare parts, rework and scrap, office supplies, and so forth have traditionally been considered the function of storage systems.

Answer 8. The following are the application of AS/RS system
12. Unit load storage and handling
13. Order picking
14. Work in process storage system
15. Finished goods storage
16. Warehousing operation
17. Distributions operation

Answer 9. The following are the components of AS/RS
(i) Storage space  (ii) Bay  (iii) Row  (iv) Aisles  (v) Aisle unit  (vi) storage rack
(vii) Storage structure (viii) S/R machine (ix) storage module (x) P/D stations.
(a) Storage space: storage space is the three dimensional space in the storage racks that is normally required to store a single load unit of material.
(b) Storage structure: a storage structure comprises storage rack and is used to store inventory item. Usually, it is a steel frame structure that is designed to handle expected size and weight of the stored items.

Answer 10. Number of cycles per hour per machine = 60 because the cycle time is 1 min
The number of S/R machine = system throughput/(S/R machine capacity in cycle/h)
= (360 operations/h)/(60 cycles/h per machine)=6

Answer 11. The Deep-Lane AS/RS is variation on unit load system. The items are stored in multi deep storage with up to 10 items per row rather than single and double deep. This leads to high density of stored items, permitting high usages of unit. Each rack permits flow through items; that is an item is deposited on one side of the storage rack and removed from the other side. The S/R vehicle operates in the aisles and delivers load to a rack entry vehicles. The rack entry vehicle is typically a moving platform that carries the load in to storage rack, deposits it there, and returns to the S/R machine for the next load.