**SAGAR INSTITUTE OF RESEARCH TECHNOLOGY-EXCELLENCE**

Department of Mechanical Engineering

Sub: CAD/CAM/CIM Sub.Code: ME-804

## UNIT-I

**1 Define the production activity controls.**

**Ans.** Production activity control can be defined as the process which involves the co – ordination of the manufacturing resources – scheduled and controlled. Production activity control includes the various activities related to the scheduling, releasing and the tracking production orders and schedules and then reporting the materials and the resources used and the results of the production process.With the help of the Production Activity Control, one can easily meet the timely completion of the various orders by starting the various operations in time as per the plan. Effective Production Activity Control is also responsible for meeting the delivery commitments. Production Activity Control acts as the modules of the MRP/ERP systems, and involves mainly four procedures – releasing, scheduling, monitoring, updating.

- **Functions of the Production Activity Control**

  1.Helps in the planning.
  2. Helps in the execution of the plan.
  3. Ensures availability of the resources.
  4. Releases the shop orders.
  5. Schedules start and completion dates of the jobs.
  6. Collects required information for the shop order.
  7. Helps in controlling the operations.
  8. Establishes order priority.
  9. Maintains order priority.
  10. Checks actual performance.
  11. Monitors and controls WIP, lead times.
  12. Reports work center performance.

- **Role of the Production Activity Control**

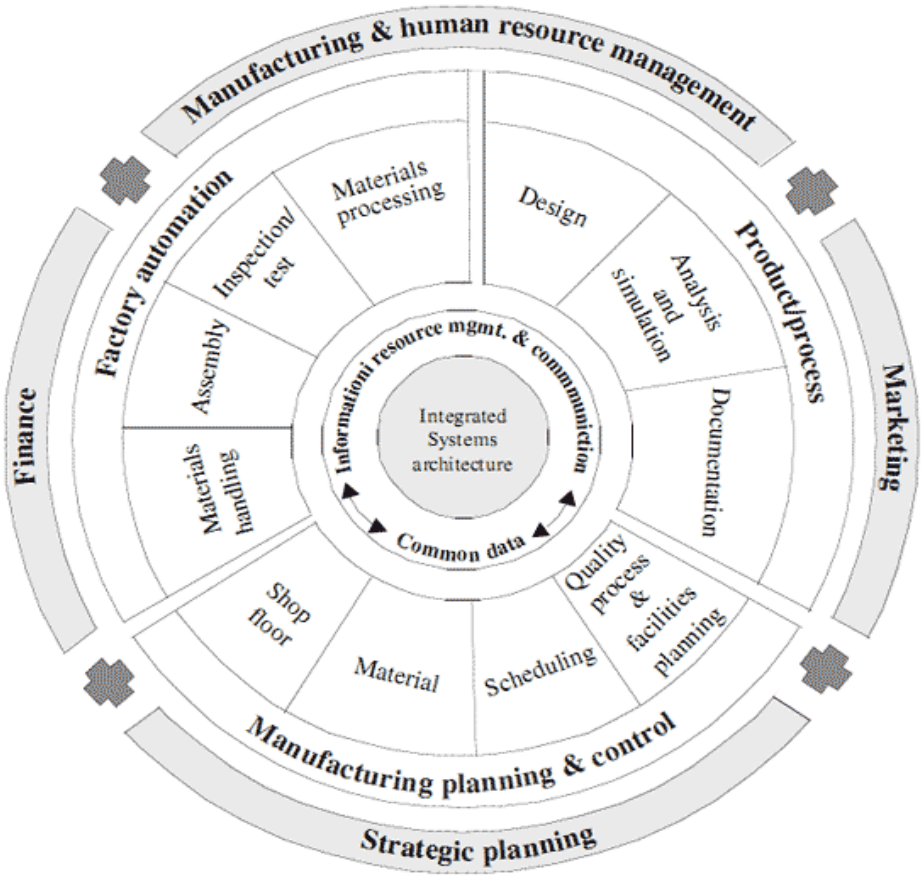
  1. Manages the shop floor production task.
  2. Controls the production work flow.

3. Aims achievement of the production plans.
4. Prepares the schedules.

**2 Define CIM. Draw and discuss CIM wheel.**

**Ans. Computer integrated manufacturing** (**CIM**) is the manufacturing approach of using computers to control the entire production process. This integration allows individual processes to exchange information with each other and initiate actions. Although manufacturing can be faster and less error-prone by the integration of computers, the main advantage is the ability to create automated manufacturing processes. It is also known as *flexible design and manufacturing*. Computer-integrated manufacturing is used in automotive, aviation, space, and ship building industries. The term "computer-integrated manufacturing" is both a method of manufacturing and the name of a computer-automated system in which individual engineering, production, marketing, and support functions of a manufacturing enterprise are organized. In a CIM system functional areas such as design, analysis, planning, purchasing, cost accounting, inventory control, and distribution are linked through the computer with factory floor functions such as materials handling and management, providing direct control and monitoring of all the operations.

**CIM Wheel-**



**THE OUTER RING**

- The common business administrative tasks related to CIM are located on the outer ring of the wheel.
- They mainly form the connection of the company to the outside world
- Data processing applications can be found in the most diverse areas.
- Most software systems applied in these areas were originally self-styled developments, which are increasingly being replaced with commercial standard software packages.
- Currently this software is installed primarily on mainframes.

**THE INNER RING**

- On the inner ring of the wheel, the functions closely related to the operational performance of the company are situated.
- Data processing applications of the development and design area are computer aided design (CAD), simulations, analysis programs such as the finite element method (FEM) as well as drawing storage and management, for instance with the help of GT.
- The types of data found in this area are diverse:
- drawings, technical specifications, and bills of material.
- In manufacturing companies, the data itself are often in considerable disorder.
- Frequently there are several types of part numbers, more than one group technology system, many kinds of bills of material, a number of different CAD systems each having its own sort of computer internal representation of geometric data, etc.
- The applied software rarely runs on the same hardware, resulting also in a large number of different hardware systems.
- The second group is attributed to process planning and PPC.
- It comprises tasks such as routing generation, resource planning, material requirements planning, capacity planning, order distribution and supervision, but also the planning of quality assurance.
- As in the common business administrative area, the software packages-which at least are integrated within themselves-have a modular structure and their single components can also be bought and applied.

**3 Define computer integrated manufacturing. Explain the different elements of CIM.**

**Ans.** The Society of Manufacturing Engineers (SME) defined CIM as 'CIM is the integration of the total manufacturing enterprise through the use of integrated systems and data communications coupled with new managerial philosophies which results in the improvement of personnel or organizational efficiencies.

**Objective of CIM**

- Simplify production processes, product design and factory organisation, as these are vital foundation to automation and integration
- To reduce lead time, costs and inventory
- Automate production processes And automate business functions that support them with computers, machines and robots.
- To coordinate and organize data effectively

**The elements of CIM system**

**i. Marketing:**

- The need for a product is identified by the marketing division.
- Marketing department decides
    - Specifications of the product,
    - Projection of manufacturing quantities
    - Marketing strategy for the product.
- Marketing also works out the manufacturing costs to assess the economic viability of the product.

**ii. Product Design:**

- Complex designs are usually carried out by several teams working simultaneously, located often in different parts of the world.
- The design process is constrained by the costs that will be incurred in actual production and by the capabilities of the available production equipment and processes.
- The design process creates the database required to manufacture the part.

**iii. Planning:**

- Involves several subsystems: dealing with
- materials,
- facility,
- process,

- tools,
- manpower,
- capacity,
- scheduling,
- outsourcing,
- assembly, inspection, logistics etc.

**iv. Purchase:**

- The purchase departments is responsible for
    - placing the purchase orders and follow up
    - ensure quality in the procurement process
    - receive the items
    - arrange for inspection
    - supply the items to the stores
    - arrange timely delivery of items depending on the production schedule for eventual supply to manufacture and assembly.

**v. Manufacturing Engineering:**

- ME include
- online dynamic scheduling and
- control based on the real time performance of the equipment and processes
- to assure continuous production activity.
- The need to meet fluctuating market demand requires the manufacturing system to be flexible and agile.

**vi. Factory Automation Hardware:**

- Factory automation equipment further enriches the database with equipment and process data to carry out the production process.
- In CIM system this consists of computer controlled process machinery such as CNC machine tools, flexible manufacturing systems (FMS), Computer controlled robots, material handling systems (MHS), computer controlled assembly systems, automated inspection systems and so on.

**vii. Warehousing:**

- Warehousing is the function involving storage and retrieval of raw materials, components, finished goods as well as shipment of items.

- In today's complex outsourcing scenario and the need for just-in-time supply of components and subsystems, logistics and supply chain management assume great importance.

**viii. Finance:**

- Finance deals with the resources pertaining to money.
- Major tasks of the finance department are:
    - Planning of investment,
    - working capital, (Arrangement)
    - cash flow control,
    - realization of receipts,
    - allocation of funds
    - accounting

**ix. Information Management:**

- Information Management is the most crucial tasks in CIM.
- This involves:
    - master production scheduling,
    - database management,
    - communication,
    - manufacturing systems integration
    - management information systems.
    -

**4 What are the advantages of CIM system.**

**Ans**. Many of the firms that are currently using CIM have reported a number of improvements including:

- 15-30 % reduction in engineering design cost,
- 30-60 % reduction in overall lead times,
- 40-70% gain in overall production,
- 200-500 % gain in quality
- 30-60 % reduction in working progress.

**5 Define aggregate production planning? Explain various input required for it.**

**Ans.** Aggregate planning' is a marketing activity that does an aggregate plan for the production process, in advance of 6 to 18 months, to give an idea to management as to what quantity of materials and other resources are to be procured and when, so that the total cost of operations of the organization is kept to the minimum over that period.

The quantity of outsourcing, subcontracting of items, overtime of labor, numbers to be hired and fired in each period and the amount of inventory to be held in stock and to be backlogged for each period are decided. All of these activities are done within the framework of the company ethics, policies, and long term commitment to the society, community and the country of operation.

Aggregate planning has certain pre-required inputs which are inevitable. They include:

- Information about the resources and the facilities available.
- Demand forecast for the period for which the planning has to be done.
- Cost of various alternatives and resources. This includes cost of holding inventory, ordering cost, cost of production through various production alternatives like subcontracting, backordering and overtime.
- Organizational policies regarding the usage of above alternatives.

**6. Write importance between batch and job production.**

**Ans. Batch Procduction:**
A manufacturing process in which components or goods are produced in groups (batches) and not in a continuous stream.

**Characteristics of Batch Production:**

1. Shorter production runs.
2. Plant and machinery are flexible.
3. Plant and machinery set up is used for the production of item in a batch and change of set up is required for processing the next batch.
4. Manufacturing lead-time and cost are lower as compared to job order production.

**Benefits**

1. Better utilisation of plant and machinery.
2. Promotes functional specialisation.
3. Cost per unit is lower as compared to job order production.
4. Lower investment in plant and machinery.
5. Flexibility to accommodate and process number of products.
6. Job satisfaction exists for operators.

**Limitations**

1. Material handling is complex because of irregular and longer flows.
2. Production planning and control is complex.
3. Work in process inventory is higher compared to continuous production.
4. Higher set up costs due to frequent changes in set up.

**Job Shop Production**

A job shop is a type of manufacturing process in which small batches of a variety of custom products are made.In the job shop process flow, most of the products produced require a unique set-up and sequencing of process steps. Job shops are usually businesses that perform custom parts manufacturing for other businesses.

However, examples of job shops include a wide range of businesses—a machine tool shop, a machining center, a paint shop, a commercial printing shop, and other manufacturers that make custom products in small lot sizes. These businesses deal in customization and relatively small production runs, not volume and standardization.

**Characteristics:**
1. High variety of products and low volume.
2. Use of general purpose machines and facilities.
3. Highly skilled operators who can take up each job as a challenge because of uniqueness.
4. Large inventory of materials, tools, parts.
5. Exhaustive planning is essential for sequencing the requirements of each product, capacities for each work centre and order priorities.

**Benefits**
1. Because of general purpose machines and facilities variety of products can be produced.
2. Operators will become more skilled and competent, as each job gives them learning opportunities.
3. Full potential of operators can be utilised.
4. Opportunity exists for Creative methods and innovative ideas.

**Limitations**
1. Higher cost due to frequent set up changes.
2. Higher level of inventory at all levels and hence higher inventory cost.
3. Production planning is complicated.
4. Larger space requirements.

**7.Define the lead time.**

**Ans.** lead time is the latency between the initiation and execution of a process. For example, the lead time between the placement of an order and delivery of a new car from a manufacturer may be anywhere from 2 weeks to 6 months. In industry, lead time reduction is an important part of lean manufacturing. n the manufacturing environment, lead time has the same definition as that of Supply Chain Management, but it includes the time required to ship the parts from the supplier. The shipping time is included because the manufacturing company needs to know when the parts will be available for material requirements planning. It is also possible for lead time to include the time it takes for a company to process and have the part ready for manufacturing once it has been received. The time it takes a company to unload a product from a truck, inspect it, and move it into storage is non-trivial. With tight manufacturing constraints or when a company is using Just In Time manufacturing it is important for supply chain to know how long their own internal processes take.

Lead time is made of:

- **Preprocessing Lead Time** (also known as "planning time" or "paperwork"): It represents the time required to release a purchase order (if you buy an item) or create a job (if you manufacture an item) from the time you learn of the requirement.
- **Processing Lead Time**: It is the time required to procure or manufacture an item.
- **Postprocessing Lead Time**: It represents the time to make a purchased item available in inventory from the time you receive it (including quarantine, inspection, etc.)

**Example**

Company A needs a part that can be manufactured in two days once Company B has received an order. It takes three days for company A to receive the part once shipped, and one additional day before the part is ready to go into manufacturing.

- If Company A's Supply Chain calls Company B they will be quoted a lead time of 2 days for the part.
- If Company A's Manufacturing division asks the Supply Chain division what the lead time is, they will be quoted 5 days since shipping will be included.
- If a line worker asks the Manufacturing Division boss what the lead time is before the part is ready to be used, it will be 6 days because setup time will be included.

**In more detail**

Lead Time terminology has been defined in greater detail.[2] The Supply Chain from customer order received to the moment the order is delivered is divided into five lead times.

- **Order Lead Time** - Time from customer order received to customer order delivered.
- **Order Handling Time** - Time from customer order received to sales order created.
- **Manufacturing Lead Time** - Time from sales order created to production finished (ready for delivery).
- **Production Lead Time** - Time from start of physical production of first sub module/part to production finished (ready for delivery).
- **Delivery Lead Time** - Time from production finished to customer order delivered.

**8. Define Master Production scheduling.**

**Ans.** A master production schedule (MPS) is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the planindicates when and how much of each product will be demanded.

**9.Explain the following a.MRP b.CAPP**

**Ans. a. MRP-** Material Requirements Planning is a computer-based production planning and inventory control system. MRP is concerned with both production scheduling and inventory control. It is a material control system that attempts to keep adequate inventory levels to assure that required materials are available when needed.

Independent demand is demand originating outside the plant or production system, while dependent demand is demand for components. The bill of materials (BOM) specifies the relationship between the end product (independent demand) and the components (dependent demand). MRP takes as input the information contained in the BOM.

The basic functions of an MRP system include: inventory control, bill of material processing, and elementary scheduling. MRP helps organizations to maintain low inventory levels. It is used to plan manufacturing, purchasing and delivering activities.

"Manufacturing organizations, whatever their products, face the same daily practical problem - that customers want products to be available in a shorter time than it takes to make them. This means that some level of planning is required."

Companies need to control the types and quantities of materials they purchase, plan which products are to be produced and in what quantities and ensure that they are able to meet current and future customer demand, all at the lowest possible cost. Making a bad decision in any of these areas will make the company lose money. A few examples are given below:

- If company purchases insufficient quantities of an item used in manufacturing (or the wrong item) it may be unable to meet contract obligations to supply products on time.
- If company purchases excessive quantities of an item, money is wasted - the excess quantity ties up cash while it remains as stock that might never be used at all.
- Beginning production of an order at the wrong time can cause customer deadlines to be missed.

MRP is a tool to deal with these problems. It provides answers for several questions:

- *What* items are required?
- *How many* are required?
- *When* are they required?

MRP can be applied both to items that are purchased from outside suppliers and to sub-assemblies, produced internally, that are components of more complex items.

**b. Computer-aided process planning** (**CAPP**) is the use of computer technology to aid in the process planning of a part or product, in manufacturing. CAPP is the link between CAD and CAM in that it provides for the planning of the process to be used in producing a designed part CAPP is a linkage between the CAD and CAM module. It provides for the planning of the process to be used in producing a designed part. Process planning is concerned with determining the sequence of individual manufacturing operations needed to produce a given part or product. The resulting operation sequence is documented on a form typically referred to as a route sheet (also called as process sheet/method sheet) containing a listing of the production operations and associated machine tools for a work part or assembly. Process planning in manufacturing also refers to the planning of use of blanks, spare parts, packaging material, user instructions (manuals) etc.

The term "computer-aided production planning" is used in different contexts on different parts of the production process; to some extent CAPP overlaps with the term "PIC" (production and inventory control).

Process planning translates design information into the process steps and instructions to efficiently and effectively manufacture products. As the design process is supported by many computer-aided tools, computer-aided process planning (CAPP) has evolved to simplify and improve process planning and achieve more effective use of manufacturing resources.

Process planning is of two types as:

1. Generative type computer aided process planning.
2. Variant type process planning.

**10 What is PLM?**

**Ans. Product lifecycle management** (**PLM**) is the process of managing the entire lifecycle of a product from inception, through engineering design and manufacture, to service and disposal of manufactured products. PLM integrates people, data, processes and business systems and provides a product information backbone for companies and their extended enterprise.

**Benefits of PLM**

- Reduced time to market
- Increase full price sales
- Improved product quality and reliability
- Reduced prototyping costs
- More accurate and timely request for quote generation
- Ability to quickly identify potential sales opportunities and revenue contributions
- Savings through the re-use of original data
- A framework for product optimization
- Reduced waste
- Savings through the complete integration of engineering workflows
- Ability to provide contract manufacturers with access to a centralized product record
- Seasonal fluctuation management
- Improved forecasting to reduce material costs
- Maximize supply chain collaboration

**11. What are the database requirements for CIM?**

**Ans. DATA BASE**

- A data base can be defined as a collection of data in a single location designed to be used by different programmers for a variety of applications.

- The term database denotes a common base of data collection designed to be used by different programmers.

- More specifically it is a collection of logically related data stored together in a set of files intended to serve one or more applications in an optimal fashion.
- A database not only stores the data but also provides several ways to view the data depending upon the needs of the user.
- **OBJECTIVES OF DATABASE**

  A database serves the following objectives:

  • Reduce or eliminate redundant data

  • Integrate existing data

  • Provide security

  • Share data among users

  • Incorporate changes quickly and effectively

  • Exercise effective control over data

  • Simplify the method of using data

  • Reduce the cost of storage and retrieval of data

  • Improve accuracy and integrity of data

**12. Define CAM.**

**Ans. Computer-Aided Manufacturing** Computer-aided manufacturing (CAM) is defined as the effective use of computer technology in manufacturing planning and control.

CAM is most closely associated with functions in manufacturing engineering, such as process planning and numerical control (NC) part programming.

CAM can be divided into two broad categories:

(1) manufacturing planning

(2) manufacturing control

**a) Manufacturing Planning**

- CAM applications for manufacturing planning are those in which the computer is used indirectly to support the production function, but there is no direct connection between the computer and the process.
- The computer is used "off-line" to provide information for the effective planning and management of production activities.
- The Manufacturing planning areas include:
- Computer-aided process planning (CAPP)
- Computer-assisted NC part programming
- Computerized mach inability data systems.
- Cost estimating,
- Production and inventory planning.
- Computer-aided line balancing.

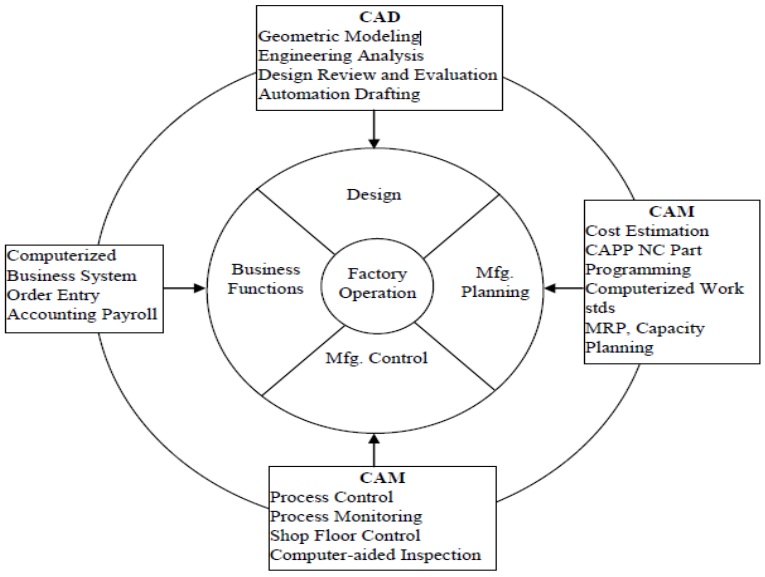
**b) Manufacturing Control.**

- The second category of CAM application is concerned with developing computer systems to implement the manufacturing control function.
- Manufacturing control is concerned with managing and controlling the physical operations in the factory
- These management and control areas include:
- Process monitoring and control
- Quality control
- Shop floor control
- Inventory control
- Just-in-time production systems

**13. What is the role of CAD CAM in CIM.**

**Ans.** Customer orders are initially entered by the company's sales force into a computerized order entry system.

- The orders contain the specifications describing the product.
- New products are designed on a CAD system.
- Components that comprise the product are designed, the bill of materials BOM is compiled, and assembly drawings are prepared.
- Output of the design department serves as the input to manufacturing engineering, where process planning. tool design, and similar activities are accomplished to prepare for production.
- Process planning is performed using CAPP.
- Tool and fixture design is done on a CAD system, making use of the product model generated during product design.
- The output from manufacturing engineering provides the input to production planning and control, where material requirements planning and scheduling are performed using the computer system.




**Computerized elements of a CIM system**