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1. **Aim and objective of the subject**

   To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

2. **Need and importance for study of the subject**

   The student can able to understand the use of computers in process planning and use of FMS and Robotics in CIM.

LESSON PLAN:

Sl. No.	WEEK	Topics	No of Hours	Book No.
UNIT-I : INTRODUCTION OF CIM				
1	WEEK I	Brief introduction to CAD and CAM	1	T1,R1
2		Manufacturing Planning, Manufacturing control	1	T1,R1
3		Introduction to CAD/CAM – Concurrent Engineering	1	T1,R1
4		CIM concepts – Computerised elements of CIM system –Types of production	1	T1,R1
5		Manufacturing models and Metrics – Mathematical models of Production Performance Simple problems	1	T1,R1
6	WEEK II	Manufacturing Control – Simple Problems	1	T1,R1, R3
7		Basic Elements of an Automated system.	1	T1,R1
8		– Levels of Automation	1	T1,R1
9		Lean Production	1	T1,R1
10		Just-In-Time Production	1	T1,R1
UNIT – II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING				
11		Process planning – Computer Aided Process Planning (CAPP)	1	T1,R1, R3

Sl. No.	WEEK	Topics	No of Hours	Book No.
12	WEEK III	Logical steps in Computer Aided Process Planning	1	T1,R1, R3
13		Aggregate Production Planning	1	T1,R1, R3
14		Master Production Schedule	1	T1,R1, R3
15		Material Requirement planning	1	T1,R1, R3
16	WEEK IV	Capacity Planning- Control Systems	1	T1,R1, R3
17		Shop Floor Control-Inventory Control	1	T1,R1, R3
18		Brief on Manufacturing Resource Planning-II (MRP-II)	1	T1,R1, R3
19		Enterprise Resource Planning (ERP)	1	T1,R1, R3
20		Simple Problems.	1	T1,R1
UNIT – III : CELLULAR MANUFACTURING				
21	WEEK V	Group Technology(GT), Part Families	1	T1,R1
22		– Parts Classification and coding –	1	T1,R1
23		Simple Problems in Opitz Part Coding system	1	T1,R1
24		Production flow Analysis	1	T1,R1
25		Cellular Manufacturing	1	T1,R1
26	WEEK VI	Composite part concept, Machine cell design and layout	1	T1,R1
27		Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method	1	T1,R1
28		Arranging Machines in a GT cell	1	T1,R1
29		Hollier Method – Simple Problems	1	T1,R1

Sl. No.	WEEK	Topics	No of Hours	Book No.
UNIT – IV : FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)				
30		Types of Flexibility - FMS – FMS Components	1	T1,R1
31	WEEK VII	FMS Application & Benefits	1	T1,R1
32		FMS Planning and Control	1	T1,R1
33		Quantitative analysis in FMS – Simple Problems.	1	T1,R1
34		Automated Guided Vehicle System (AGVS)	1	T1,R1
35		AGVS Application	1	T1,R1
36	WEEK VIII	Vehicle Guidance technology	1	T1,R1
37		Vehicle Management & Safety	1	T1,R1
UNIT – V : INDUSTRIAL ROBOTICS				
38		Robot Anatomy and Related Attributes	1	T1,R1
39		Classification of Robots- Robot Control systems	1	T1,R1
40		End Effectors – Sensors in Robotics	1	T1,R1
41	WEEK IX	Robot Accuracy and Repeatability	1	T1,R1, R2
42		Industrial Robot Applications	1	T1,R1, R2
43		Robot Part Programming	1	T1,R1, R2
44		Robot Accuracy and Repeatability	1	T1,R1, R2
45		Simple Problems	1	T1,R1, R2

UNIT – I

INTRODUCTION OF CIM

PART-A

1. Define CIM.

CIM is the integration of the total manufacturing enterprise through the use of integrated systems and data communications coupled with new managerial philosophies that improve organizational and personnel efficiency.

2. What are the elements of CIM?

The applications of CIM can be divided into two broad categories.

1. Business functions
2. Product design
3. Manufacturing planning
4. Manufacturing control

3. Define manufacturing planning.

The information and documentation that constitute the product design flows into the manufacturing planning function. The information-processing activities in manufacturing planning include process planning, master scheduling, requirements planning, and capacity planning.

4. Define manufacturing control.

Manufacturing control is concerned with managing and controlling the physical operations in the factory to implement the manufacturing plans. Manufacturing control functions are shop floor control, inventory control, and quality control.

5. Define concurrent Engineering.(Nov/Dec 2016)

Concurrent engineering refers to an approach used in product development in which the functions of design engineering, manufacturing engineering, and other functions are integrated to reduce the elapsed time required to bring a new product to market. Also called **simultaneous engineering**, it might be thought of as the organizational counterpart to CAD/CAM technology.

6. Define automation.

Automation is generally defined as the process of having machines follow a predetermined sequence of operations with little or no human labour, using specialized equipment and devices that performs and control manufacturing processes.

7. What are the functions of automated manufacturing system?

Automating manufacturing systems operate in the factory on the physical product. They perform operations such as processing, assembly, inspection, or material handling, in some cases accomplishing more than one of these operations in the same systems.

8. Define production rate.

The production rate for an individual processing or assembly operation is usually expressed as an hourly rate, that is, parts or products per hour. Let us consider how this rate is determined for the three types of production: job shop production, batch production, and mass production.

9. What are the levels of automation?

* Device level * Machine level * Cell or system level

* Plant level * Enterprise level

10. Define JIT.

The ideal just-in-time production system produces and delivers exactly the required number of each component to the downstream operation in the manufacturing sequence just at the time when that component is needed. Each component is delivered "just in time."

11. What are the benefits of automation?

- To reduce labour cost
- To mitigate the effects of labour shortages
- To reduce or eliminate routine and clerical takes
- To improve worker safety.
- To increase the labour productivity.

12. What are the objectives of JIT?

- Zero defect *Zero setup time * Zero inventories
- Zero handling * Zero breakdowns * Zero lead time

13. What are the elements of JIT?

- Reduce or eliminate setup time.
- Reduce manufacturing and purchasing lot sizes
- Reduce production and delivery lead times

- Preventive maintenance
- Stabilize and level the production schedule with uniform plant loading
- Flexible workspace.

14. What are the types of production?

- Low production; Quantities in the range of 1 to 100 units per year.
- Medium production: Quantities in the range of 100 to 10,000 units annually.
- High production; Production quantities are 10,000 to millions of units.

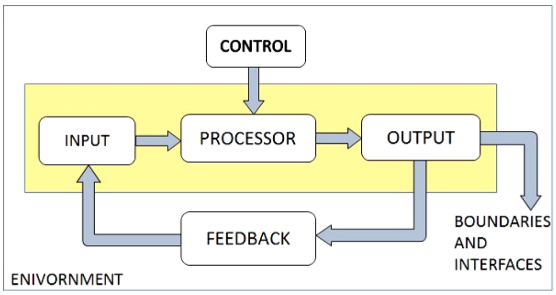
15. What are the three basic elements of an automated system? (Nov/Dec 2016)

Basic elements of an automated system:

- Power to accomplish the process and operate the system.
- A program of instructions to direct the process.
- A control system to actuate the instructions.

16. Illustrate the components of an automated system with simple sketch.(Apr/May2017)

- Push-button panels, with or without visual displays.
- Touch-panel displays, with fixed or programmable screen layouts.
- Computer keyboards and monitors.
- Hand-held remote controls.
- Telephone interfaces to allow long-distance remote control.
- Television controllers with on-screen menus.

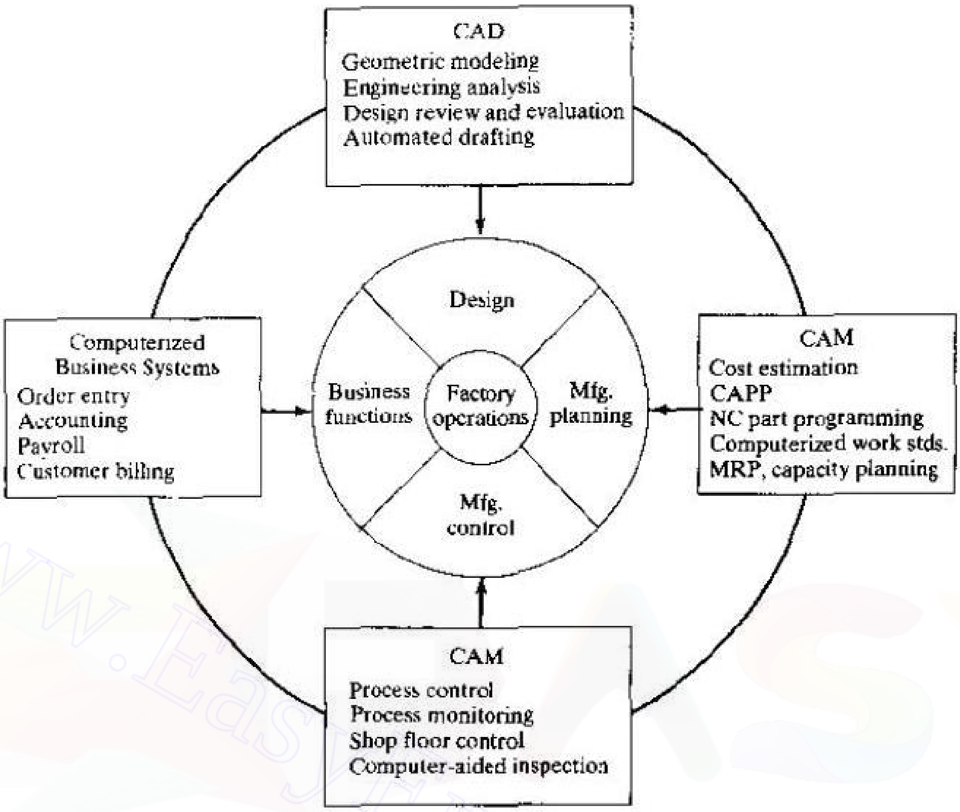


17. What are the factors that lead to the evolution of CIM? (Apr/May2017)

- CAD (computer-aided design)
- CAE (computer-aided engineering)
- CAM (computer-aided manufacturing)
- CAPP (computer-aided process planning)
- CAQ (computer-aided quality assurance)
- PPC (production planning and control)
- ERP (enterprise resource planning)

PART-B

1. Explain the computerized elements of CIM system.



Computerized elements of a CIM system.

Business Functions: The business functions are the principal means of communicating with the customer. They are therefore, the beginning and the end of the information-processing cycle. Included in this category are sales and marketing, sales forecasting, order entry, cost accounting, and customer billing.

Product Design: If the product is to be manufactured to customer design, the design will have been provided by the customer. The manufacturer's product design department will not be involved. If the product is to be produced to customer specifications, the manufacturer's product design department maybe contracted to do the design work for the product as well as to manufacture it. If the product is proprietary the manufacturing firm is responsible for its development and design. The cycle of events that initiates a new product design often originates in the sales and marketing department. The departments of the firm that are organized to accomplish product design might include research and development, design engineering, drafting, and perhaps a prototype shop.

Manufacturing Planning: The information and documentation that constitute the product design flows into the manufacturing planning function. The information processing activities in manufacturing planning include process planning. master scheduling, requirements planning, and capacity planning. *Process planning* consists of determining the sequence of individual processing and assembly operations needed to produce the part. The manufacturing engineering and industrial engineering departments are responsible for planning the processes and related technical derails,

Manufacturing planning includes logistics issues.

Manufacturing control: Manufacturing control is concerned with managing and controlling the physical operations in the factory to implement the manufacturing plans. Manufacturing control functions are shop floor control, inventory control, and quality control.

2. Explain the mathematical models of production performance.
(Nov/Dec 2016)

In some manufacturing operations, the percentage of scrap produced is high enough to adversely affect production rate, plant capacity, and product costs.

Production Rate:

The production rate for an individual processing or assembly operation is usually expressed as an hourly rate, that is, parts or products per hour. Let us consider how this rate is determined for the three types of production: job shop production, batch production, and mass production.

For any production operation. the operation cycle time T, is defined as the time that one work unit spends being processed or assembled. It is the time between when one work unit begins processing (or assembly) and when the next unit begins. T, is the time an individual part spends at the machine, but not all of this time is productive. In a typical processing operation. Such as machining time, T consists of:

- Actual machining operation time.
- Work part handling time
- Tool handling time per work piece.

Production Capacity:

Production capacity is defined as the maximum rate of output that a production facility is able to produce under a given set of assumed operating conditions. The production facility usually refers to a plant or factory, and so the term plant capacity is often used for this measure. As mentioned before, the assumed operating conditions refer to the number of shifts per day.

Plant capacity is typically defined as one or two shifts, In the manufacture of discrete parts and production growing trend is to define plant capacity {or the full 7-day week, 24 hr/day.

$$PC = nSHR_p$$

Where PC = production capacity of the facility (output units/wk),

n = number of work centers producing in the facilities = number of shifts per period (shift/wk),

H = hr/5hift, and

R_p = hourly production rate of each work center (output units/hr).

Utilization and Availability:

It refers to the amount of output of a production facility relative to its capacity. Expressing this as an equation,

$$U = \frac{Q}{Pc}$$

Where, U- Utilization of the facility,

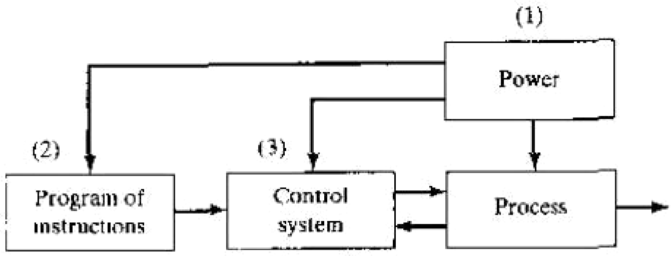
Q- Actual quantity produced by the facility during a

Given time period, and

Pc - production capacity for the same period.

Utilization can be assessed for an entire plant, a single machine in the plant, or any other productive resources. For convenience, it is often defined as the proportion of time that the facility is operating relative to the time available under the definition of capacity, utilization is usually expressed as a percentage.

3. Explain the basic elements an automated system.



Elements of an automated system: (1) power, (2) program of instructions, and (3) control systems.

An automated system consists of three basic elements:

- Power to accomplish the process and operate the system.
- A program of instructions to direct the process, and
- A control system to actuate the instructions.

The relationship amongst these elements is illustrated in figure. All systems that qualify as being automated include these three basic elements in one form or another.

Power to Accomplish the Automated Process:

An automated system is used to operate some process, and power is required to drive the processes as well as the controls. The principal source of power in automated systems is electricity. Electric power has many advantages in automated as well as non-automated processes

•Electrical power is widely available at moderate cost. It is an important part of our industrial infrastructure.

• Electrical power can be readily converted 10 alternative energy forms: mechanical, thermal, light, acoustic, hydraulic, and pneumatic.

• Electrical power at low levels can be used to accomplish functions such as signal transmission, information processing, and data storage and communication.

• Electrical energy can be stored in long-life batteries for use in locations where an external source of electrical power is not conveniently available.

Alternative power sources include fossil fuels, solar energy, water, and wind. However, their exclusive use is rare in automated systems. In many cases when alternative power sources used to drive the process itself, electrical power is used for the controls that automate the operation. For example, in casting or heat treatment, the furnace may be heated by fossil fuels. But the control system to regulate temperature and time cycle is electrical. In other cases, the energy from these alternative sources is converted to electric power to operate both the process and its automation.

Program of Instructions:

The actions performed in an automated process are defined by a program of instructions whether the manufacturing operation involves low, medium, or high production, each part or product style made in the operation requires one or more processing steps that are unique to that style, these processing steps are performed during a work cycle. A new part is completed during each work cycle. The particular processing steps for the work cycle are specified in a work cycle program.

Work cycle programs are called part programs in numerical control. Other process control applications use different names for this type of program. Work Cycle Programs. In the simplest automated processes, the work cycle consists of essentially one step, which is to maintain a single process parameter at a defined level, for example, maintain the temperature of a furnace at a designated value for the duration of a heat treatment cycle. In this case, programming simply involves sensing the temperature dial on the furnace, to change the program, the operator simply changes the temperature setting. An extension of this simple case is when the single-step process is defined by more than one process parameter, for example, a furnace in which both temperature and atmosphere are controlled. In more complicated systems, the process involves a work cycle consisting of multiple steps that are repeated with no deviation from one cycle to the next. Most discrete part manufacturing operations are in this category a typical sequence of steps is:

1) Load the part into the production machine,
2) Perform the process, and
3) Unload the part.

During each step, there are one or more activities that involve changes in one or more process parameters. Process parameters are inputs to the process.

Control System:

The control element of the automated system executes the program of instructions. The control system causes the process to accomplish its defined function, which for our purpose is to carry out some manufacturing operation. Let us provide a brief introduction to control systems here.

The controls in an automated system can be either closed loop or open loop. A closed loop control system, also known as a feedback control system is one in which the output variable is compared with an input parameter, and any difference between the two is used to drive the output into agreement with the input. A closed loop control system consists of six basic elements:

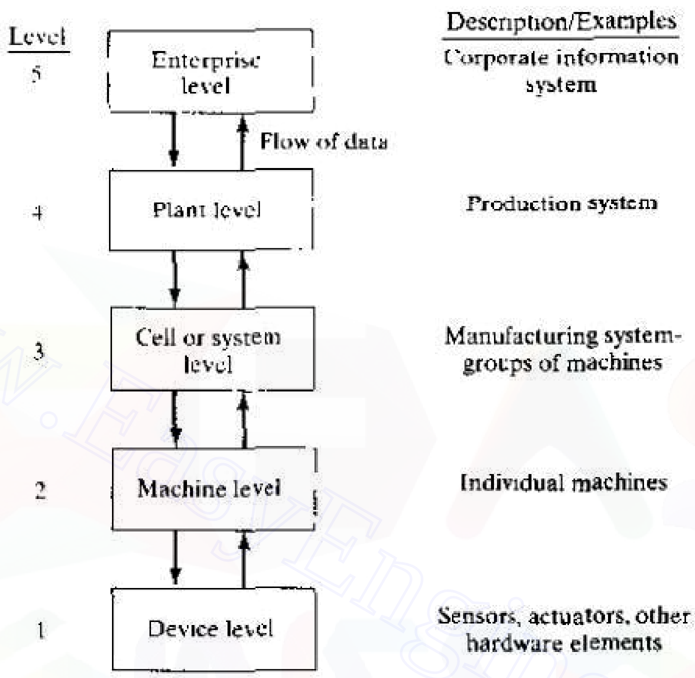
- Input parameter,
- Process,
- Output variable
- Feedback sensor.
- Controller. and
- Actuator.

The input parameter often referred to as the set point, represents the desired value of the output.

4. Explain the various level of automation.(Apr/May 2017)

LEVELS OF AUTOMATION:

The concept of automated systems can be applied to various levels of factory operations. One normally associates automation with the individual production machines. However, the production machine itself is made up of subsystems that may themselves be automated.



Five levels of automation and control in manufacturing.

Device level:

This is the lowest level in our automation hierarchy. It includes the actuators, sensors, and other hardware components that comprise the machine level. The devices are combined into the individual control loops of the machine.

Machine level:

Hardware at the device level is assembled into individual machines. Examples include CNC machine tools and similar production equipment, industrial robots, powered conveyors, and automated guided vehicles. Control functions at this level include performing the sequence of steps in the program of instructions in the correct order and making sure that each step is properly executed.

Cell or system level:

This is the manufacturing cell or system level, which operate under instructions from the plant level. A manufacturing cell or system is a group of machines or workstations connected and supported by a material handling system, computer. and other equipment appropriate to the manufacturing process. Production lines are included in this level. Functions include part dispatching and machine loading. Coordination among machines, material handling system, and collecting and evaluating inspection data.

Plant level:

This is the factory or production systems level. It receives instructions from the corporate information system and translates them into operational plans for production. Likely functions include: order processing, process planning, inventory control, purchasing, material requirements planning, shop floor control, and quality control.

Enterprise level:

This is the highest level consisting of the corporate information system. It is concerned with all of the functions necessary to manage the company. Marketing and sales, accounting, design, research, aggregate planning, and master production scheduling.

5. Explain the lean production.(Nov/Dec 2016)

Lean production can he defined as an adaptation of mass production in which workers and work cells are made more flexible and efficient by adopting methods that reduce waste in all forms. According to another author of The Machine that Changed the World, lean production is based on four principles

1. Minimize waste
2. Perfect first-time quality
3. Flexible production lines
4. Continuous improvement

Minimize Waste: All four principles of lean production are derived from the first principle: minimize waste.

(1)Production of defective parts,

(2) Production of more than till number of items needed,

(3) Unnecessary inventories,

(4) Unnecessary processing steps,

(5) Unnecessary movement of people,

(6) Unnecessary transport of materials, and

(7) Workers waiting.

Perfect First-Time Quality: In the area of quality, the comparison between mass production and lean production provides a sharp contrast. In mass production, quality control is defined in terms of an acceptable quality level. This means that a certain level of fraction defects is sufficient, even satisfactory. In lean production, by contrast, perfect quality is required. The just-in-time delivery discipline used in lean production necessitates a zero defects level in parts quality, because if the part delivered to the downstream workstation is defective, production stops. There is minimum inventory in a lean system to act as a buffer. In mass production, inventory buffers are used just in case these quality problems occur. The defective work units are simply taken off the line and replaced with acceptable units; However, the problem is that such a policy tends to perpetuate the cause of the poor quality. Therefore, defective parts continue to be produced. In lean production a single defect draws attention to the quality problem, forcing corrective action and a permanent solution. Workers inspect their own production, minimizing the delivery of defects to the downstream production station.

Flexible Production Systems: In mass production, the goal is to maximize efficiency. This is achieved using long production runs of identical parts. Long production runs tolerate long setup changeovers, In lean production procedures are designed to speed the changeover. Reduced setup times allow for smaller batch sizes. Thus providing the production system with greater flexibility. Flexible production systems were needed in Toyota's comeback