USN | | | | | | | | | | |

Internal Assessment Test 4 – February 2022

Sub	Computer Aided Design & Manufacturing (CADM)					Sub Code:	18ME72	Branch	Mech	
Date	02.02.22	Duration	10.15 AM 11.45 AM	Max Marks	50	Sem / Sec	VII/A&B		OBE	
Answer All Questions								MARKS	CO	RBT

1	Discuss types of Automation relative to production quantity and product variety.	10	CO1	L1
2	Explain the following (i) Production capacity (ii) Utilization (iii) Manufacturing Lead Time (iv) Work in Progress (v) Availability	10	CO1	L1
3	Explain the operation of walking beam transfer system.	10	CO1	L1
4	Explain the following transformations with examples (i) Translation (ii) rotation (iii) scaling (iv) reflection (v) concatenation	10	CO1	L2
5	What is CAPP? Explain the various approaches of CAPP with advantages.	10	CO1	L1

CI **CCI** **HoD**

1.

1) Types of Automation:

1) Fixed (or) Rigid Automation
2) Programmable automation
3) Flexible Automation

1) Fixed Automation:-

As the name suggests, in this automation the sequence of operations are fixed, & easier to perform. Fixed automation is used when the volume of production is high, & product variety is low. This kind of automation is mostly suitable for mass production. Here the equipment is specially designed to produce a particular product. If the product changes the same equipment cannot be used. Fixed automation has very high production rates. overall investment is less in case of fixed automation when compared to other types of automation.

Ex:- Oil refineries, chemical processing, Assembly lines special purpose machines.

2) Programmable Automation:-

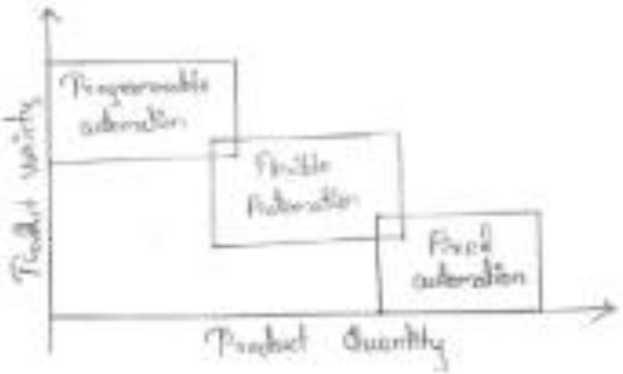
In this type of automation sequences of operations can be interchanged. The sequence of operations are controlled by program of instructions are changed but not the equipment. Programmable automation is used when production volume is low. This kind of automation is more suitable for Batch production. The product variety will be high in this automation compared to fixed automation. If the product changes, the same equipment can be used with minimal changes.

Ex:- NC machines, Industrial Robots

3) Flexible Automation:-

It is an extension of programmable automation. A flexible automation system is capable of producing a large variety of parts with virtually no time lost for change over from one part style to the next. It covers the advantages of both fixed & programmable automation.

The production rates are medium in flexible automation. The Entire System is flexible to deal with variety of products
Ex:- Automation on CNC Machines



2 ✱ 1) Production Capacity:-

Plant Capacity refers to the number of products that a production facility can produce under certain operating conditions

The various operating conditions include.

a) Number of Shifts per day(s)
b) Number of hours per Shift (h)
c) Number of workstations (n)
d) Employment levels
e) Production rate
f) Number of operations on Each unit (n_o)

Plant Capacity is given by, $P_c = n.s.h.R_p$

units: $\frac{\text{Shifts}}{\text{day}} \times \frac{\text{hours}}{\text{Shift}} \times \frac{\text{Parts}}{\text{hour}} = \frac{\text{Parts}}{\text{day}}$

Note:- In operations on Each unit is Considered then plant Capacity is given by:

$$P_c = \frac{n.s.h.R_p}{n_o}$$

ii) utilization :-

These are the two important parameters that are used to measure the performance of the manufacturing plant.

utilization represents how best the resources are used in the plant. It is denoted by 'U' & is expressed in terms of '%'

If utilization is low, it represents high investments on low returns of utilization is 100% & still the demand has not met it represents that the capacity of the plant must be increased.

utilization is also defined as the ratio of number of units to the plant capacity

$$U = \frac{Q}{P_c} \times 100$$

iii) Manufacturing lead time (MLT) :-

MLT is a total time required to process a given part throughout the plant.

It is the time elapsed b/w the customer order & the product delivery.

MLT does not include the time spent by the work part before starting the actual process.

MLT depends on different types of production system.

MLT depends on setup up time (T_{su}) & on non operational time (T_{no})

For Batch production System :

$$MLT_B = n_o \left(QT_c + T_{su} + T_{no}\right)$$ — for same cycle time, operational time, setup time for all work stations.

$$MLT_B = \sum_{i=1}^{n} \left(QT_{ci} + T_{su} + T_{no}\right)$$ — for different times for different workstations.

For Job Shop production System,

$$MLT_J = n_o \left[T_c + T_{su} + T_{no}\right]$$

$$MLT_J = \sum_{i=1}^{n} \left[T_{ri} + T_{sui} + T_{noi}\right]$$

For mass production System.

$$MLT_m = n_o \left(T_c\right)$$

$$MLT_m = \sum_{i=1}^{n} QT_c$$

v) work-in-process (WIP):-

WIP refers to the number of workparts which are located in the factory that are to be processed & the workparts which are in the processing operations

WIP refers to the cost of inventory that is in the state of being transformed from raw material to the finished product

$$WIP = \frac{A.U.P_r (MLT)}{C.H}$$

vi) Availability (A):-

Availability refers to the reliability of an equipment. It also refers how fast an equipment can be maintained & serviced

Availability depends on two reliability parameters

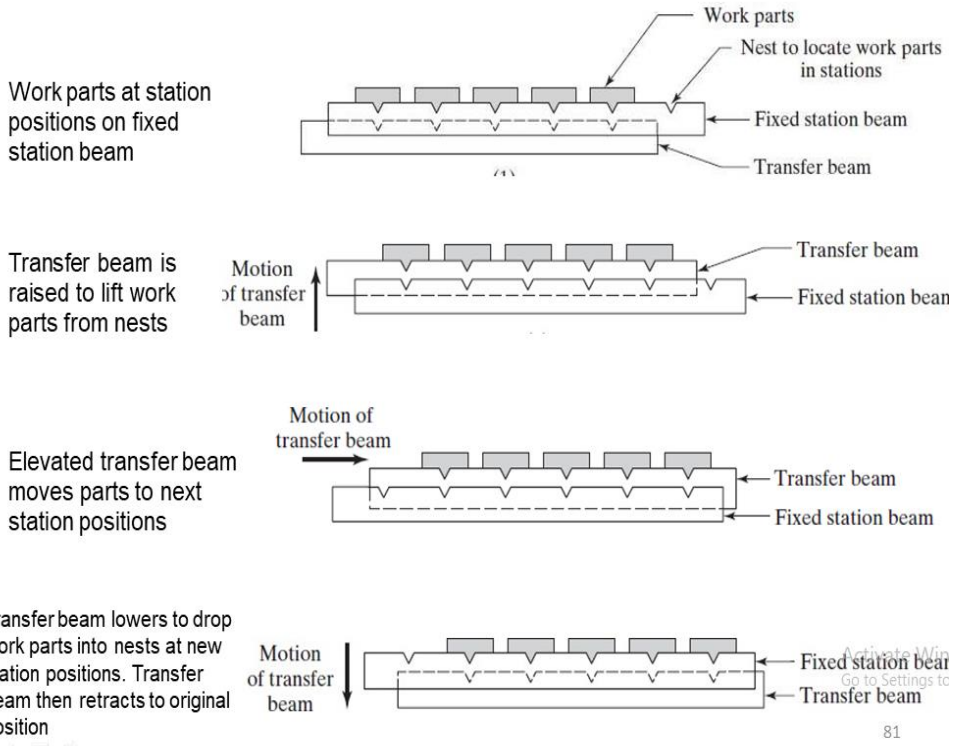
a) Mean time b/w failure (MTBF)

b) Mean time to repair (MTTR)

Availability is also expressed in terms of percentage

$$A = \frac{MTBF - MTTR}{MTBF} \times 100$$

3. Explain the operation of walking beam transfer system



With the walking beam transfer mechanism, the work-parts are lifted up from their workstation locations by a transfer bar and moved one position ahead, to the next station. The transfer bar then lowers the pans into nests which position them more accurately for processing. For speed and accuracy, the motion of the beam is most often generated by a rotating camshaft powered by an electric motor or a roller movement in a profile powered by hydraulic cylinder. Advantages: Walking beam and pusher systems are quite simple and are "clockwork" in nature. The same linear motions are repeated each time parts are indexed. They are both very efficient and able to fully utilize process resources as there is a basket or fixture in all tanks except for the short time while the transfer takes place**.**

4. Transformation means changing/Modifying entity.

(i) Translation

Moving an object is called a translation. We translate a point by adding to the x and y coordinates, respectively, the amount the point should be shifted in the x and y directions.

Translation involves moving the element to one location to other. Translation of a point (x,y) to a new position (x',y') is given by

$$x' = x + dx \text{ and } y' = y + dy$$

where,

x', y' = Co – ordinates after translation

x, y = Co – ordinates of the point before translation

dx, dy = Movement of the point in x and y direction respectively.

In matrix form, translation is represented by

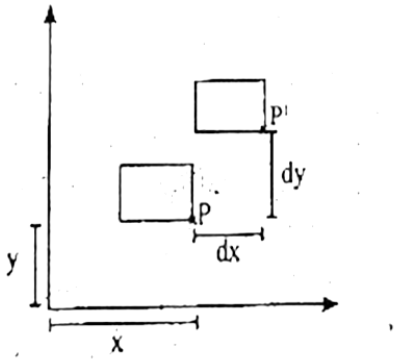
$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} m \\ n \end{bmatrix}$$

$$\Rightarrow [p'] = [p] + [T]$$

where $[p'] = \begin{bmatrix} x' \\ y' \end{bmatrix}$

$$[p] = \begin{bmatrix} x \\ y \end{bmatrix}$$

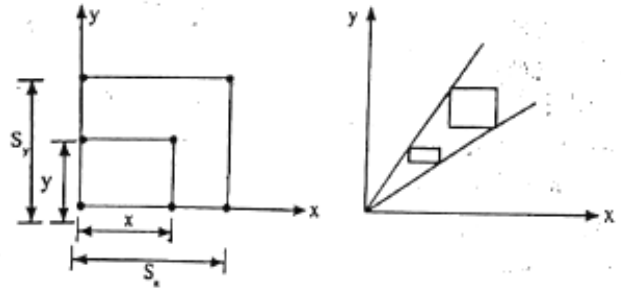
$$[T] = \begin{bmatrix} dx \\ dy \end{bmatrix} = \text{Translation matrix}$$



(iii) Scaling

Changing the size of an object is called a scale.

Scaling is used to enlarge or reduce the size of the element. Scaling factor is used to alter the size of the object and the scaling factor need not necessarily be equal in x and y directions.



The point os an element can be scaled by the scaling matrix using the following matrix equation.

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

$$[P'] = [S][P]$$

where, $[P] = \begin{bmatrix} x \\ y \end{bmatrix}$ = Original point

$[P'] = \begin{bmatrix} x' \\ y' \end{bmatrix}$ = point after scaling

$[S]$ = Scaling matrix $= \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix}$

S_x, S_y = Scaling factors in x and y directions.

(ii) Rotation

In such type of transformation, the co-ordinate points associated with the geometry are related about a point (origin) in two dimensional x - y plane. Rotation of the point takes place around z - axis.

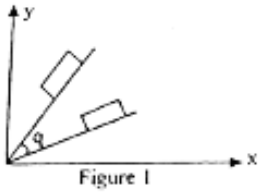
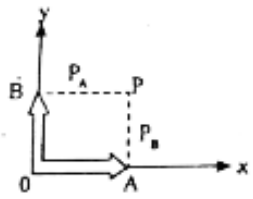


Figure 1

Consider a point 'p' attached to the axis OAB as shown in figure 1. At this stage the co-ordinates of the points w.r.t x and y axis be P_A and P_B.

$$\therefore P = \begin{bmatrix} P_A \\ P_B \end{bmatrix}$$



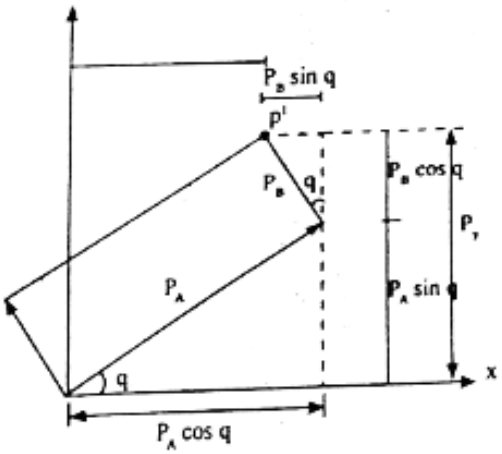
Original point before rotation

$P_A = P_x$

$P_B = P_y$

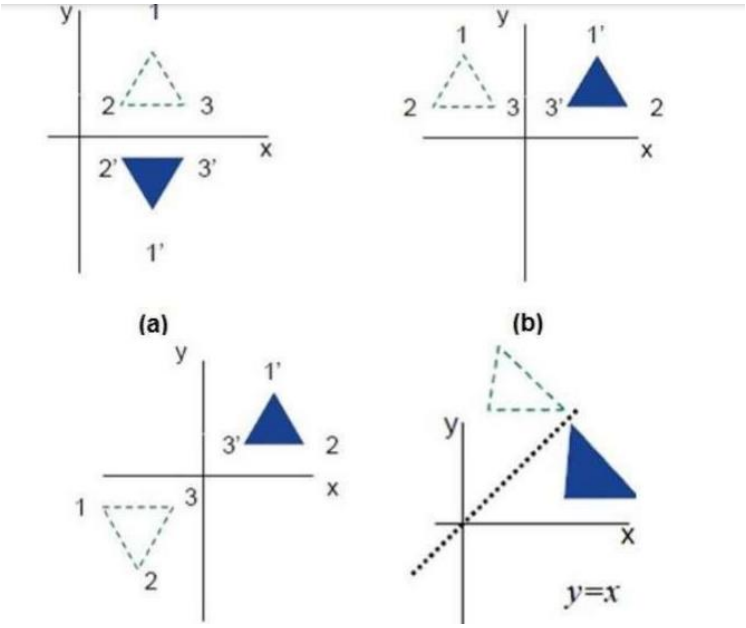
Figure 2

Let the point 'P' rotates around z -axis angle 'q' such that the axis system OAB attached the point 'P' also rotates by 'q' in counter clock wise direction.



(iv) Reflection

Reflection is the mirror image of original object. In other words, we can say that it is a rotation operation with 180°. In reflection transformation, the size of the object does not change



(v) Concatenation

More than one transformation performs in that process is called concatenation matrix

[C] = [Scaling] [Rotation]

5. Computer-aided process planning CAPP

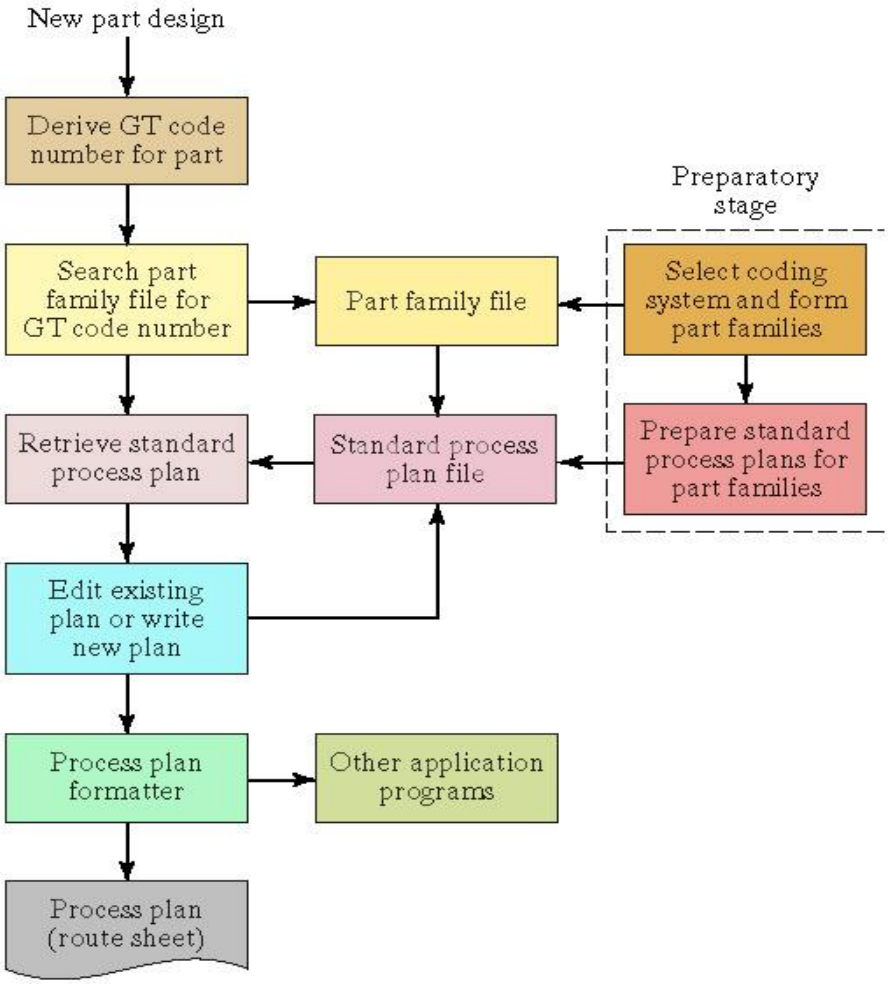
Computer-aided process planning (CAPP) helps determine the processing steps required to make a part after CAP has been used to define what is to be made. CAPP programs develop a process plan or route sheet by following approach.

(i) Variant computer aided process planning method.

(ii) Generative computer aided process planning method.

Variant process planning approach is sometimes referred as a data retrieval method. In this approach, process plan for a new part is generated by recalling, identifying and retrieving an existing plan for a similar part and making necessary modifications for new part. As name suggests a set of standard plans is established and maintained for each part family in a preparatory stage. Such parts are called master part. The similarity in design attributes and manufacturing methods are exploited for the purpose of formation of part families. Using coding and classification schemes of group technology (GT), a number of methods such as coefficient based algorithm and mathematical programming models have been developed for part family formation and plan retrieval. After identifying a new part with a family, the task of developing process plan is simple. It involves retrieving and modifying the process plan of master part of the family.

Form the Part Families by Grouping Parts →Develop Standard Process Plans →Retrieve and Modify the Standard Plans for New Parts



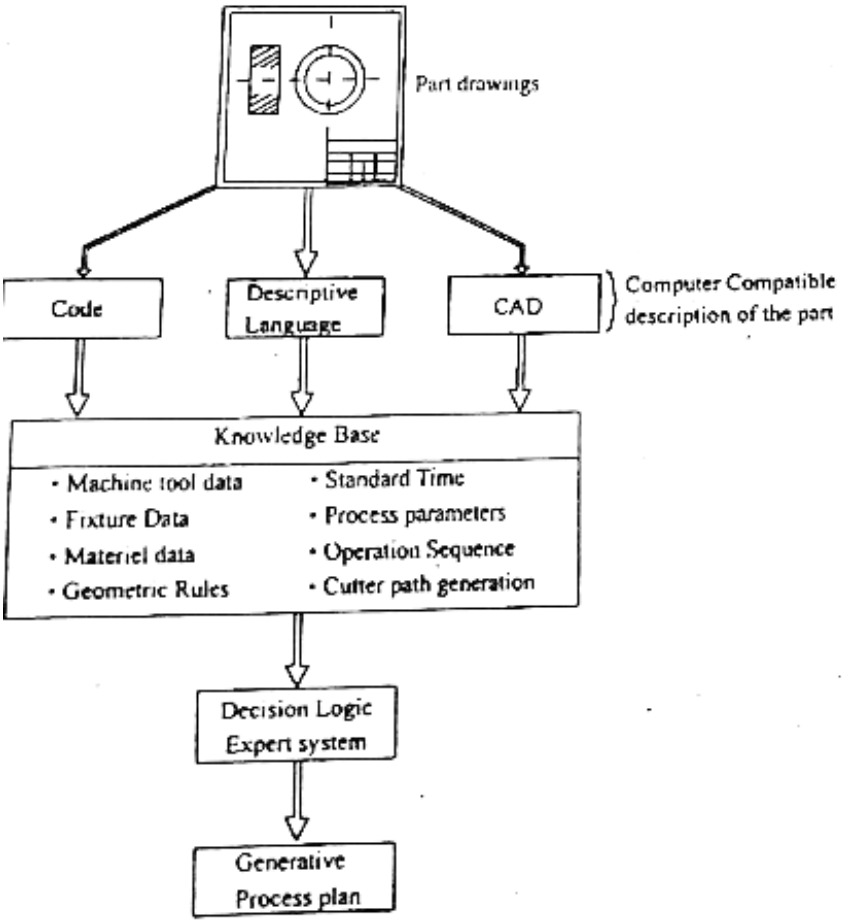
Advantages

(i) Processing and evaluation of complicated activities and managerial issues are done in an efficient manner. Hence lead to the reduction of time and labour requirement. (ii) Structuring manufacturing knowledge of the process plans to company's needs through standardized procedures.

Disadvantages

(i) It is difficult to maintain consistency during editing. (ii) Proper accommodation of various combinations of attributes such as material, geometry, size, precision, quality, alternate processing sequence and machine loading among many other factors are difficult.

In generative process planning, process plans are generated by means of decision logic, formulas, technology algorithms, and geometry based data to perform uniquely processing decisions. Main aim is to convert a part form raw material to finished state. Hence, generative process plan may be defined as a system that synthesizes process information in order to create a process plan for a new component automatically. Generative process plan mainly consists of two major components: (i) Geometry based coding scheme. (ii) Proportional knowledge in the form of decision logic and data.



Advantages

They rely less on group technology code numbers since the process, usually uses decision tree to categorize parts into families. (ii) Maintenance and updating of stored process plans are largely unnecessary. Since, any plan may be quickly regenerated by processing through the tree. Indeed, many argue that with generable systems, process plans should not be stored since if the process is changed, and out-of-dated process plan might find its way back into the system.