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Internal Assessment Test 2 – December 2021

Sub	Computer Aided Design & Manufacturing (CADM)				Sub Code:	18ME72	Branch	Mech	
Date	17.12.21	Duration	10.15 AM 11.45 AM	Max Marks	50	Sem / Sec	VII/A&B	OBE	
Answer All Questions							MARKS	CO	RBT

1	Explain the following transformations with examples (i) Translation (ii) rotation (iii) scaling (iv) reflection (v) concatenation	10	CO1	L2
2	What is CAPP? Explain the various approaches of CAPP with advantages.	10	CO1	L1
3	What is FMS? Briefly explain about FMS with neat block diagram	10	CO1	L1
4	The following data refers to the precedence relationship & element times for a new product (table below) Using Largest candidate rule method find (i) Construct the precedence diagram. (ii) If the ideal cycle time is 1 min find the no. of work stations required. (iii) Balance delay and Balance efficiency.	10	CO3	L4
5	The following data refers to the precedence relationship & element times for a new product (table below) Using Kilbridge and Westers method find (i) Construct the precedence diagram. (ii) If the ideal cycle time is 1 min find the no. of work stations required. (iii) Balance delay and Balance efficiency.	10	CO3	L4

Table in question 4:

Element No	1	2	3	4	5	6	7	8	9	10	11	12
Tc(min)	0.2	0.4	0.7	0.1	0.3	0.11	0.32	0.6	0.27	0.38	0.5	0.12
Precedence	-	-	1	1,2	2	3	3	3,4	6,7,8	5,8	9,10	11

Table in question 5:

Element No	1	2	3	4	5	6	7	8	9	10	11	12
Tc(min)	0.2	0.4	0.7	0.1	0.3	0.11	0.32	0.6	0.27	0.38	0.5	0.12
Precedence	-	-	1	1,2	2	3	3	3,4	6,7,8	5,8	9,10	11

CI **CCI** **HoD**

Computer Aided Design & Manufacturing (CADM)-18ME72

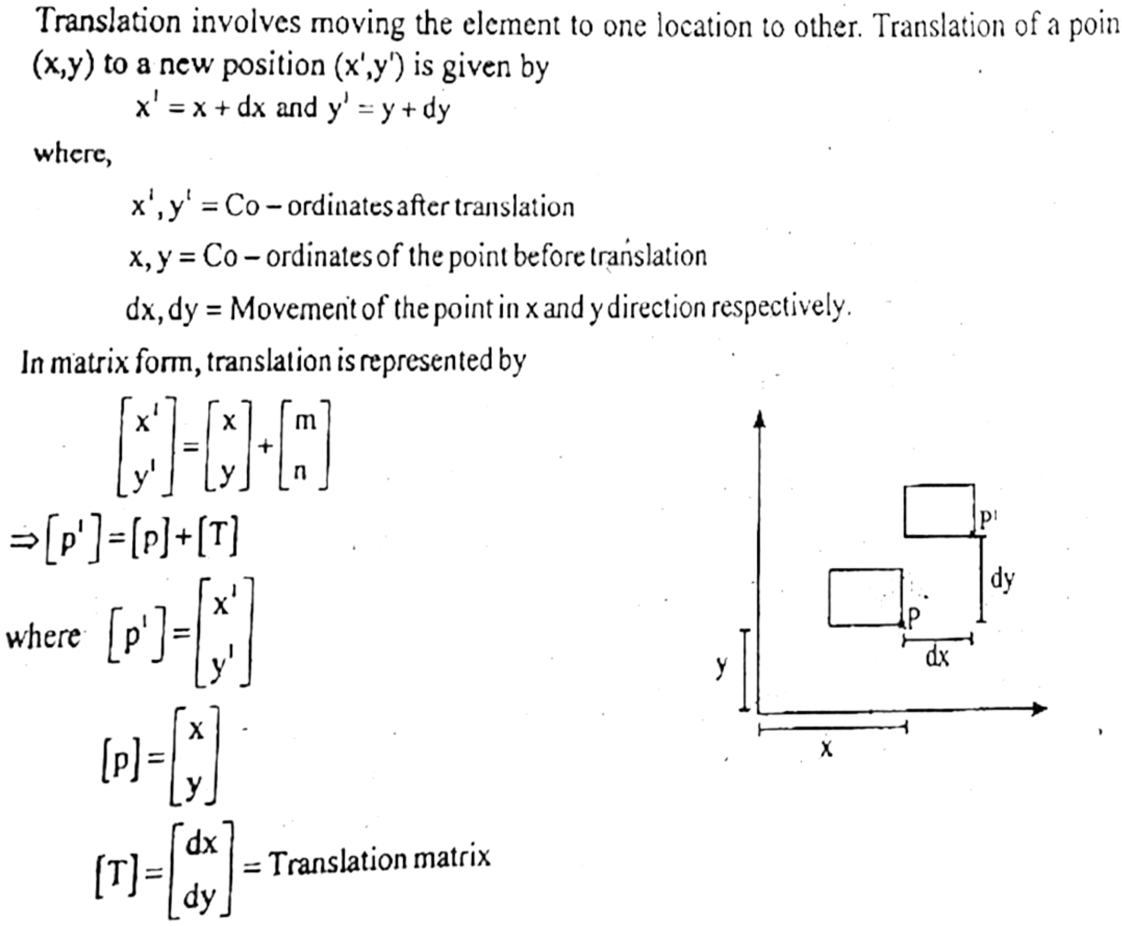
IAT 2 Scheme of Evaluation

Question Number	Particulars	Marks Distribution
1	(i) Translation	2
	(ii) rotation	2
	(iii) scaling	2
	(iv) reflection	2
	(v) concatenation	2
2	Block diagram	5
	Process	5
3	Block diagram	5
	Process	5
4	Precedence diagram	3
	Number of work station	5
	Balance delay and Balance efficiency	2
5	Precedence diagram	3
	Number of work station	5
	Balance delay and Balance efficiency	2

1. 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

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

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

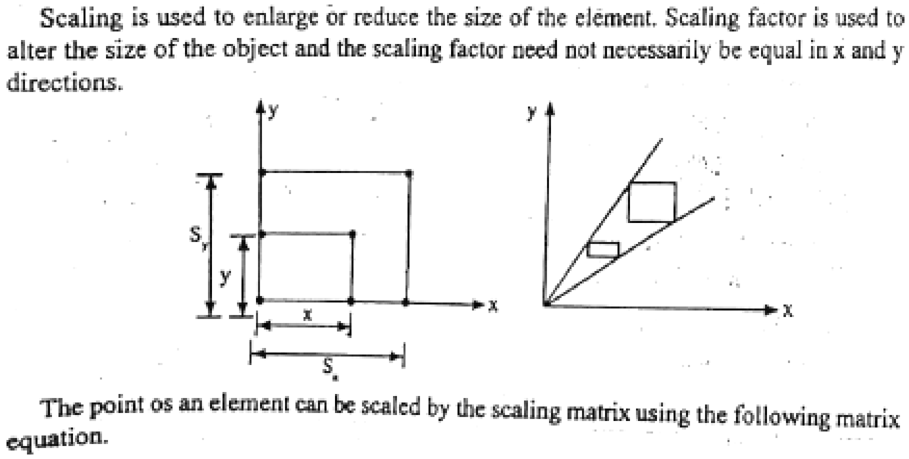
where $[p'] = \begin{bmatrix} x' \\ y' \end{bmatrix}$

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

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

(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.

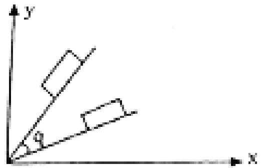
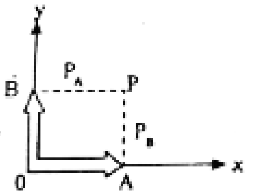


Figure 1

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.

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



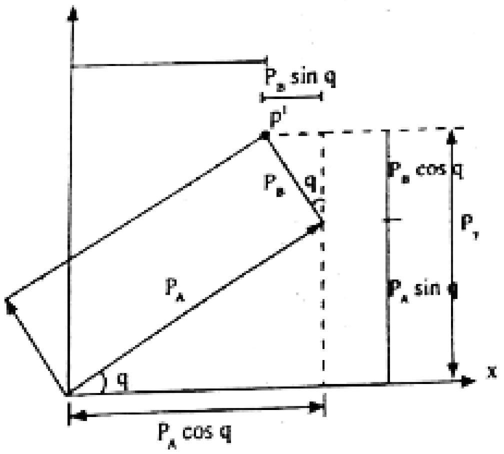
Original point before rotation

$P_A = P_x$

$P_B = P_y$

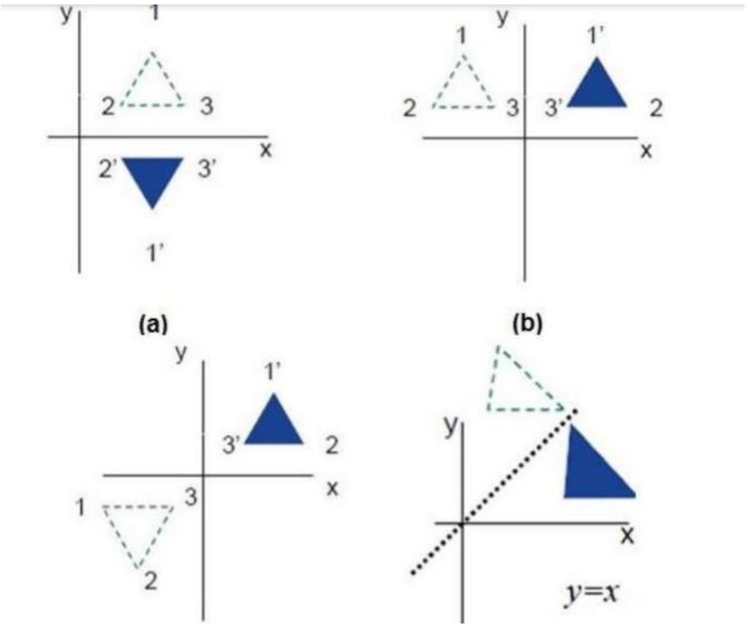
Figure 2

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]

2. Computer-aided process planning CAPP

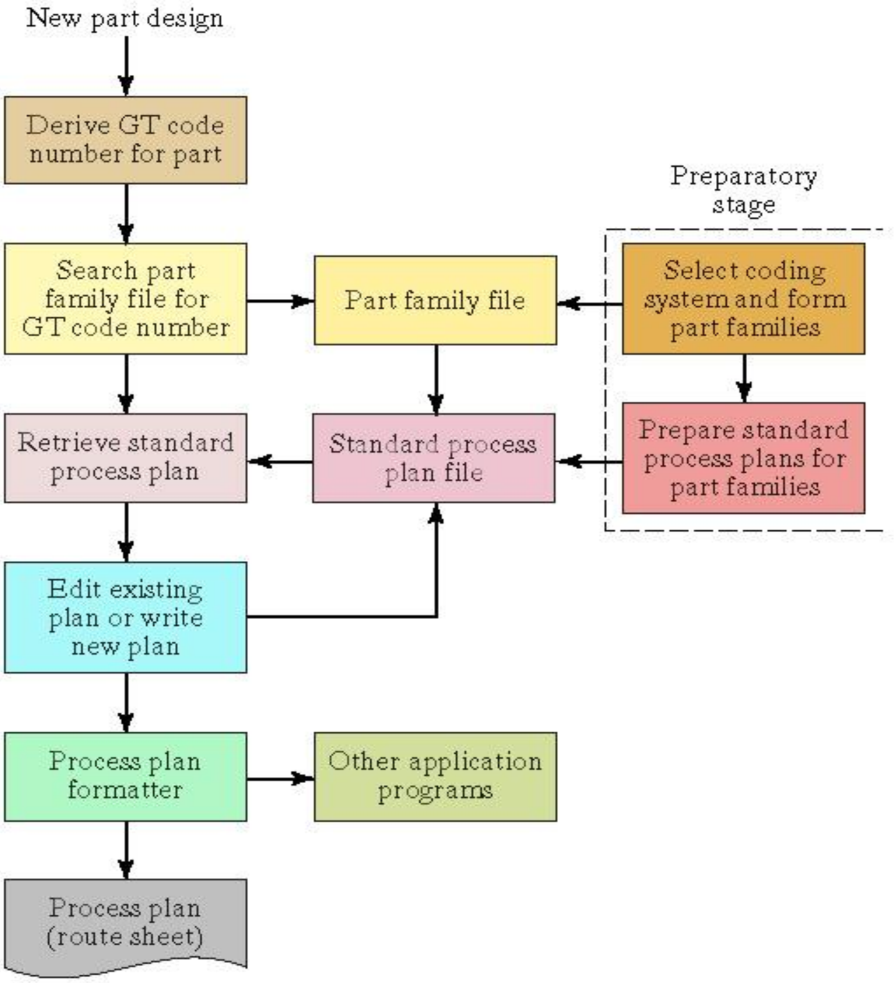
Computer-aided process planning (CAPP) helps determine the processing steps required to make a part after CAP has been used to define what is to be made. CAPP programs develop a process plan or route sheet by following approach.

(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



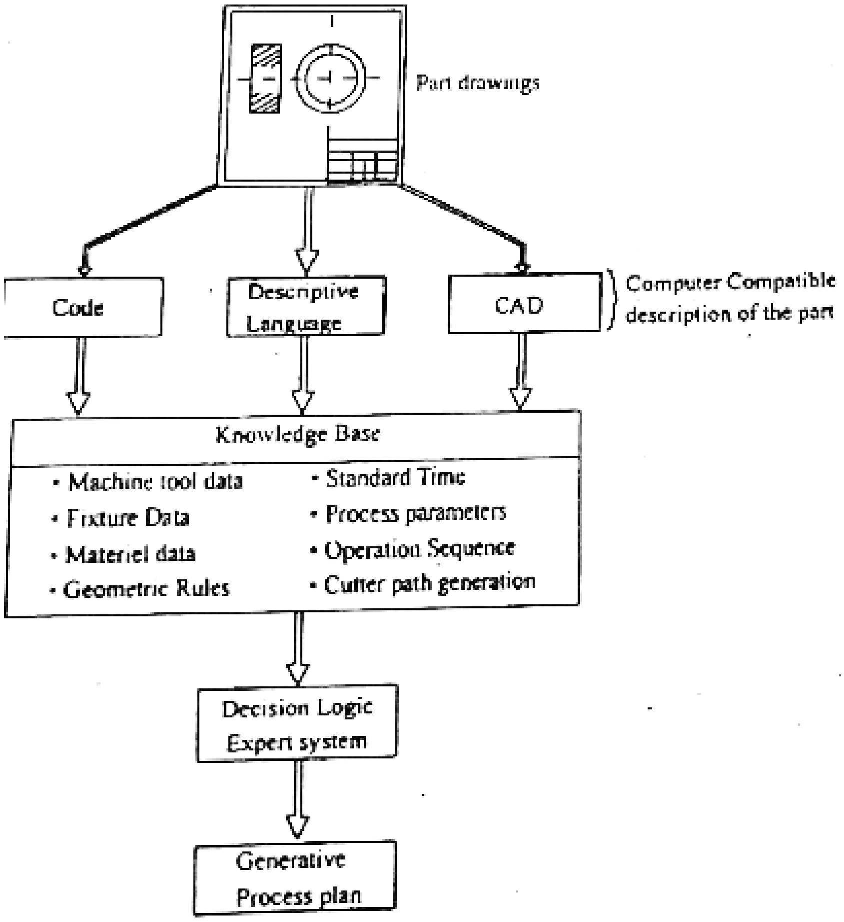
Advantages

(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.

3. FLEXIBLE MANUFACTURING SYSTEM (FMS)

"FMS is a computer controlled manufacturing system that consists of group of processing workstations interconnected by automated material handling and storage systems."

APPLICATIONS

I . Machining operations ·

2. Assembly operations

3. Sheet metal working

4. Plastic Injection Moulding

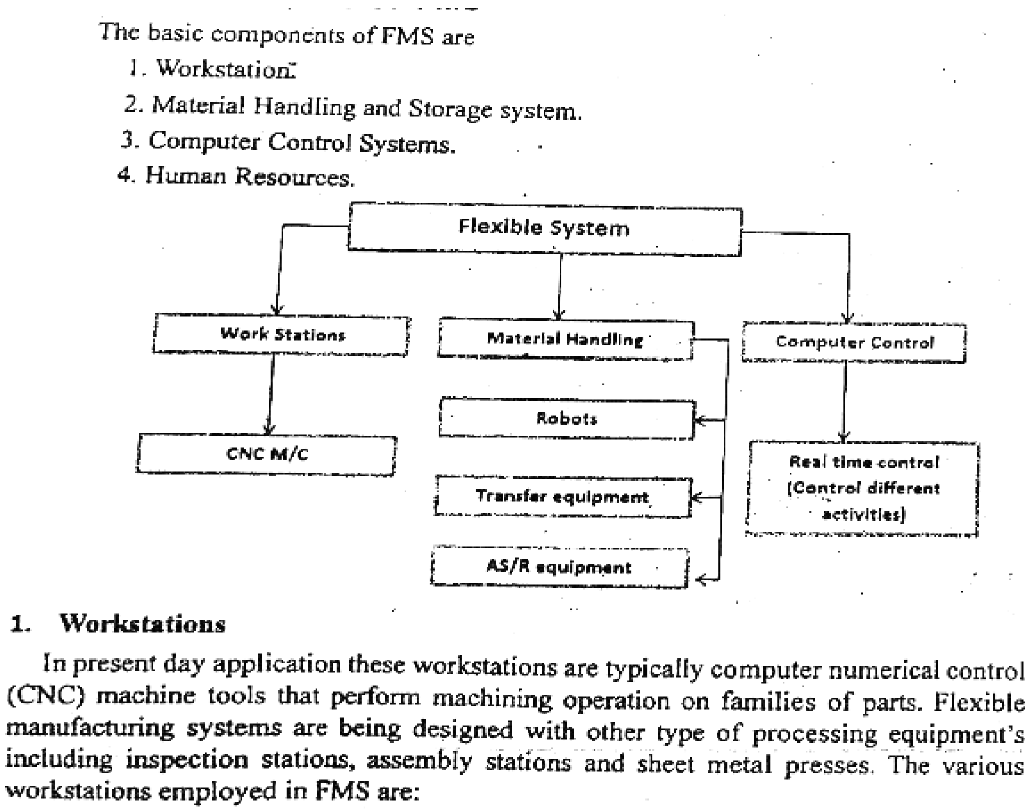
5. Press working and forging

BENEFITS

1. Reduced direct labor requirements
2. Low product costs and inventory costs
3. Low manufacturing lead times
4. Capability to incorporate changes in the product.

LIMITATIONS

1. High initial investment.
2. FMS is capable of producing limited range of part families
3. FMS is designed to produce parts within a defined range of sizes and process.



The basic components of FMS are

1. Workstation.
2. Material Handling and Storage system.
3. Computer Control Systems.
4. Human Resources.

1. Workstations

In present day application these workstations are typically computer numerical control (CNC) machine tools that perform machining operation on families of parts. Flexible manufacturing systems are being designed with other type of processing equipment's including inspection stations, assembly stations and sheet metal presses. The various workstations employed in FMS are:

a) Machining Stations
b) Load and unload stations
c) Assembly work stations
d) Inspection stations
e) Forging stations
f) Sheet metal processing, etc.

2. Material Handling and Storage system

Various types of automated material handling systems are used to transport work parts and subassembly parts between the processing stations, sometimes incorporating storage into function. Basically two types of material handling systems are included in FMS.

a) *Primary material handling systems*

These are responsible for moving work parts between stations in the system. The different types of Primary material handling system are in-line transfer systems, conveyor systems, rail guided vehicle systems, automated guided vehicle systems and industrial robots.

b) *Secondary material handling systems*

These are responsible for transferring the work parts from primary system to processing stations and to position the parts at the workstations for processing or assembly operations. These systems also act as storage buffers and are used to reorient the parts if necessary.

The various functions of automated material handling and storage system are:

a) Random and independent movement of work parts between workstations allowing various routing alternatives.
b) Handling of a variety of work part configurations.
Pallet fixtures are used for handling prismatic parts and robots are employed for loading and unloading of rotational parts.
c) Temporary storage
d) Convenient access for loading and unloading of work parts
e) Compatible with computer control systems.

3. Computer Control Systems

It is used to coordinate the activities of the processing stations and the material handling system in FMS. Typical FMS computer system consists of a central computer and microcomputers controlling the individual machines and other components. The various functions of computer control system are:

a) Work station control
b) Distribution of control instructions individual work stations
c) Production control, where product quantity and product variety are controlled.

5) The following data refers to the Precedence relationship And element times for a new product

element no	1	2	3	4	5	6	7	8	9	10	11	12
Te(min)	0.2	0.4	0.7	0.1	0.3	0.11	0.32	0.6	0.27	0.38	0.5	0.12
Precedence	-	-	1	1,2	2	3	3	3,4	6,7,8	5,8	9,10	11

using Largest Candidate rule method

- Construct the precedence diagram.
- If the ideal cycle time is 1.0 min find the no of work stations required.
- Balance delay & Balance efficiency.

Sol

$T_c = 1.0 min$

Step 1: Arrange the work elements in the descending order of their element time.

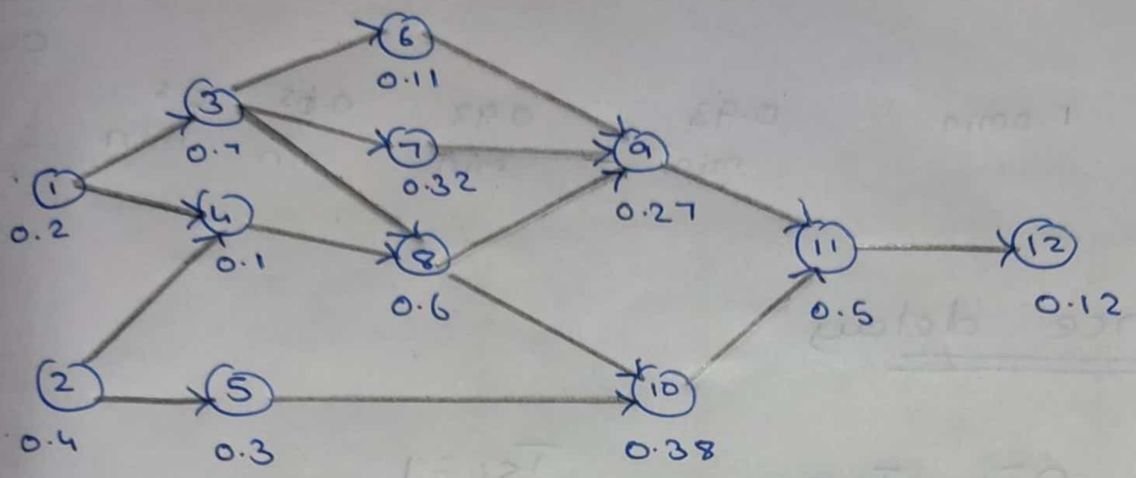
Element no	T_c (min)	Precedence.
3	0.7	1
8	0.6	3,4
11	0.5	9,10
2	0.4	—
10	0.38	5,8
7	0.32	3
5	0.3	2
9	0.32	3

1	0.2	–
12	0.12	11
6	0.11	3
4	0.1	1,2

Step2 : Assigning the work element to work station's [T = 1 min]

Element no	Tc (min)	Precedence	Station	Station time
2	0.4	–	I	0.4+0.3+0.2 +0.1=1min
5	0.3	2		
1	0.2	-		
4	0.1	1,2		
3	0.7	1	II	0.7+0.11+0.12 = 0.93 min
12	0.12	11		
6	0.1	3		
8	0.6	3,4	III	0.6+0.32 = 0.92min
7	0.32	3		
10	0.38	5,8	IV	0.38+0.27 = 0.65min
9	0.27	6,7,8		
11	0.5	9,10	V	0.5min

Step3 : Construct the precedence diagram



Step5 : Determine the theoretical number of stations required.

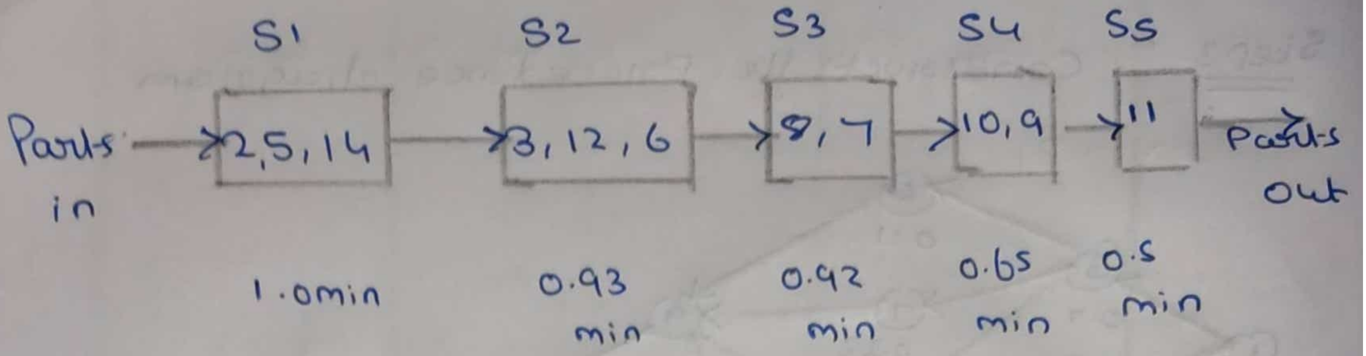
number of workstations required

$$n = \frac{T_{wc}}{T_c}$$

$T_{wc} = T_{e_1} + T_{e_2} + T_{e_3} \cdots + T_{e_{10}}$

$= 0.4 + 0.3 + 0.2 + 0.1 + 0.11 + 0.7 + 0.12 + 0.6 + 0.32 + 038$
$+ 0.27 + 0.5 = 4\text{min}$

Step6 : Computing Line balancing delay & Line Balancing efficiency.



Balance delay

$$D_b = \frac{nT_{s_i} - T_{wc}}{nT_{s_i}} \qquad T_{s_i} = 1$$

$$= \frac{5 \times 1 - 4}{5 \times 1} = \frac{1}{5} = 0.2 \Rightarrow 20$$

Balance efficiency

$$E_b = 1 - D_b$$

$$= 1 - 0.2$$

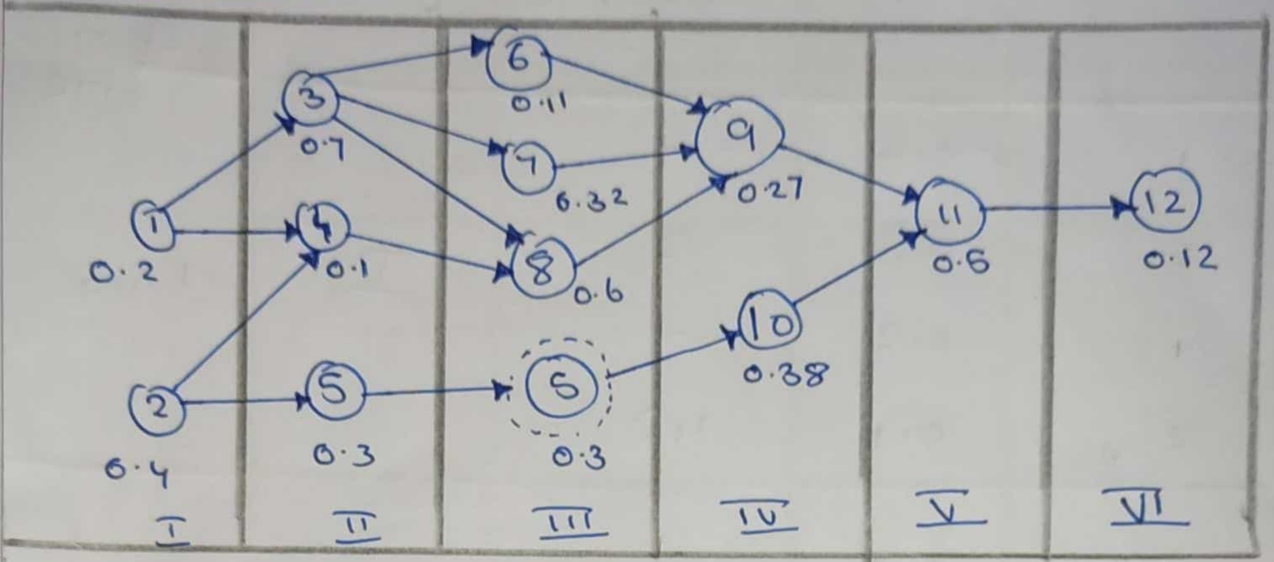
$$= 0.8$$

$$E_b = 80\% //$$

5th sum

Kilbridge and westers method

Step 1 : Precedence diagram



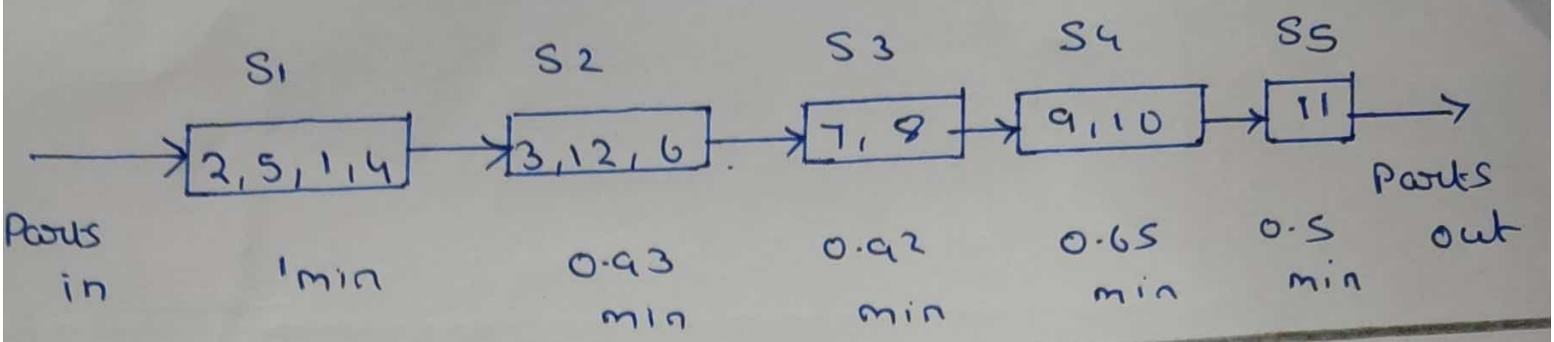
Step2 : List out elements Along column wise & According to element times in the particular column

w

work element	column	Te min	Preceded by
①	I	0.2	—
②	I	0.4	—
③	II	0.7	1
④	II	0 1	1, 2
⑤	II	0.3	2
⑥	III	0.11	3
⑦	IIII	0.32	3
⑧	III	0.6	3, 4
⑨	III	0.27	6, 7, 8
⑩	IV	0.38	5, 8
⑪	V	0.5	9, 16

Step3 : work elements assigned to the Stations according to kilbrige & westerns method

work element	Column	Tej	Perecedence	Station	Total Station time
2	1	0.4	–	I	1min
5	2	0.3	2		
1	1	0.2	–		
4	2	0.1	1,2		
3	2	0.7	1	II	0.93 min
12	6	0.12	11		
6	3	0.11	3		
7	3	0.32	3	III	0.92 min
8	4	0.6	3,4		
9	4	0.27	6,7,8	IV	0.65
10	5	0.38	5,8		
11	6	0.5	9,10	V	0.5



Balance Delay

n = 5

$$D_b = \frac{n T_{s_1} - T_{wc}}{n T_{s_1}}$$

$T_{wc} = 4$

$$= \frac{5 \times 1 - 4}{5 \times 1}$$

$= 0.2$

Balance efficiency

$E = 1 - D_b$

$E_b = 1 - 0.2$

$E_b = 80\%$