MODEL ANSWER
ESE-2013-14
AS-4217
B.TECH-VII SEM (MECHANICAL ENGG)

SECTION - A

1. :- (i) :- Low

(ii) :- (d) Disposing off property which is no longer useful in present situation.

(iii) :- Rs. 2000/-

(iv) :- Job order or Job shop production

(v) :- (d) All of the above

(vi) :- (d) Both (b) and (c) above

(vii) :- (a) An engineering problem

(viii) :- (d) All of the above

(ix) :- (b) Line balancing method

(x) :- 65 number of items will be required

(xi) :- (c) Expediting

(xii) :- (c) Job tardiness

(xiii) :- SPT (Shortest processing Time)

(xiv) (a) :- Types of production system :-

1. Job shop or order production (Unit prodn)
2. Batch production (Quantity prodn)
3. Continous production (mass prodn)

(b) Diff. b/w forecasting & prediction:-
Forecasting based on past data but prediction is not at all based on past or historical data.

(c) M.P.S:- (Master production Schedule)
" A M.P.S. is a realistic, detailed, manufacturing plan in which all possible demands are considered and put upon the manufacturing facilities"

Obj:- → support the business plan.
→ follows the company policy
→ meet all the demands.
→ minimize inventory
→ optimize resource usage.

(d) Critical Ratio:- It consider both aspects of processing time and due date information.

$$C.R. = \frac{\text{Due Date} - \text{Current date}}{\text{Remaining processing time}}$$

$$= \frac{\text{Remaining Time}}{\text{Remaining work.}}$$

(e) Line efficiency:-

$$= \frac{\text{Total Station Time (Work content)}}{\text{Cycle Time} \times \text{No of work Stations}}$$

(f) Group layout:- Combination of both product & process layout.

(g) APP Strategies:- ① pure & mixed Strategies.

(5) To ensure production of right product in right quality at the right time.

(6) To maintain flexibility in manufacturing operations, to accomodate rush jobs or to meet contingencies.

(7) To- co-ordinate labour, machines & equipment in the most effective & economic manner.

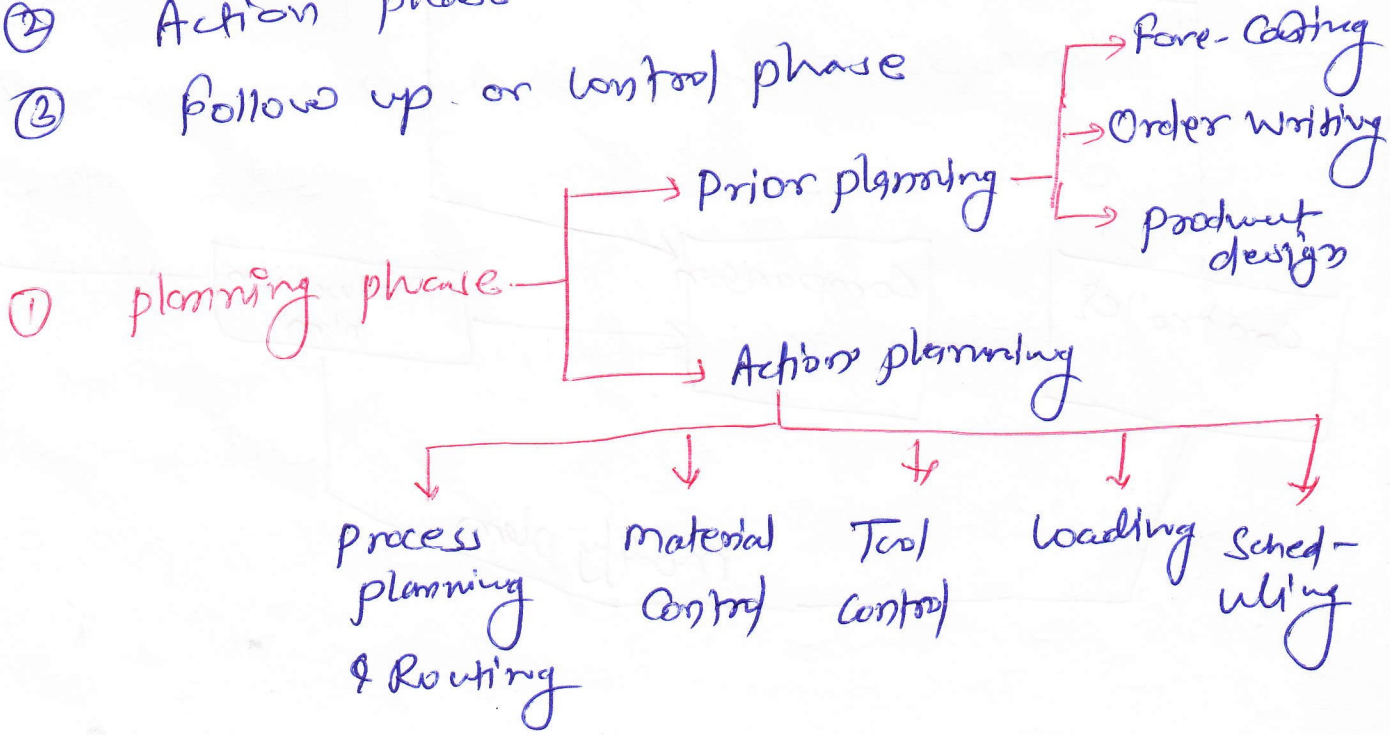
(8) Ensuring smooth flow of materials.

(9) To provide alternative production strategies in case of emergencies.

SECTION :-B
ANSWER NO-02 :- FUNCTION OF PRODUCTION PLANNING AND CONTROL

* The various functions of PPC can be classified in to three categories or phases as follows;-

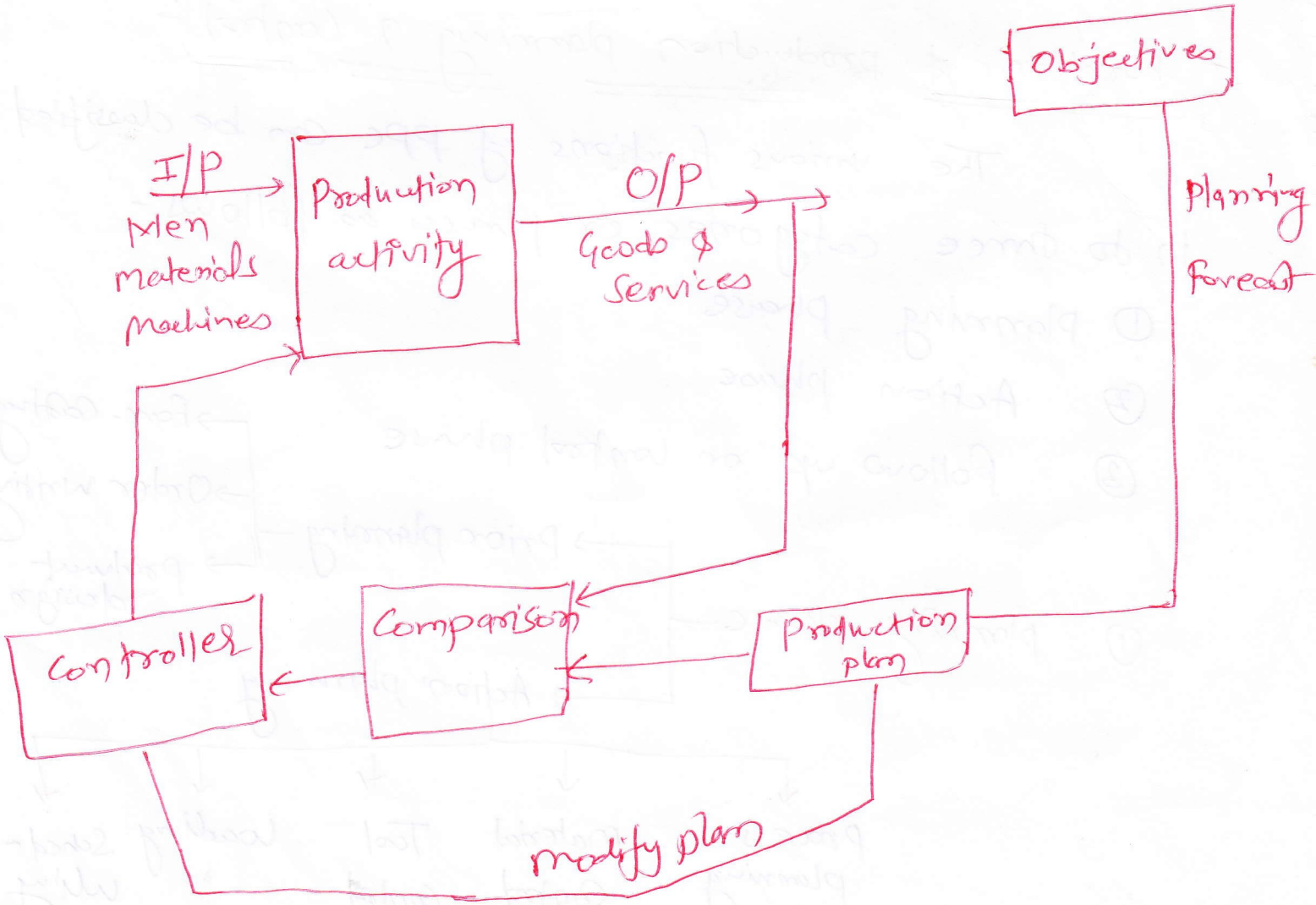
1. Planning phase
2. Action phase
3. Follow up or control phase



② Action phase :- Dispatching

③ Control phase :-
- Progress reporting
  - Data collection
  - Data interpretation
- Corrective action
  - Expediting
  - Replanning.

* Relation between production, planning & control :-



① Prior planning :-

Prior planning implies that a course of action is established in advance. The whole activity must be plan & exists on paper before the very first action takes place.

(a) Fore-casting :- (Estimation of future work) :-

Fore-casting is defined as the estimation of future activities i.e. the estimation of type, quantity and quality of future work. These estimates provide the basis for establishing the future requirement of men, materials, machines, time & money.

(b) Order writing (preparation of work authorisation) :-

If the work is to be controlled, it must begin with a specified documents authorising it. So it means giving the authority to one or more persons to do a particular job.

(c) Product design :- (preparation of specification) :-

After the work authorisation has been prepared the next step is to collect the information necessary to describe the work in details. This includes blue prints or drawings, a list of specifications a bill of materials and so on.

② Action planning :-

In any type of work activity the following steps are necessary for planning details of the work to be done;

ⓐ Process planning :- The determination of most economical method of performing an activity, all factors being considered.

Routing :- The arrangement of work stations is determined by the route.

ⓑ Material Control :- Determination of material requirements and control of materials (inventory control)

ⓒ Tool Controls :- It may be sub divided into two categories;

→ Design & procurement of new tools.
→ Control Storage & maintenance of tools after procurement.

ⓓ Loading :- Determination and control of equipments and manpower requirements. Loading may be defined as the assignment of work to the facility. The facility may be equipment, manpower or both.

(1) Scheduling:- Determination when the work is to be done. It consist of time phasing of loading (workload) i.e. setting both, starting & ending time for the work to be done.

The common practice that routing, loading and scheduling be performed simultaneously.

(2) Action phase:-

The work is started in the action phase. There is only on production planning activity in action phase i.e. dispatching. Dispatching is the transition form the planning phase to action phase.

It consists of actual release of detailed work authorisation to the work centers.

(3) Follow up or control phase:-

Once the work is started in an activity it is necessary to evaluate continuously the progress in terms of plan so that deviations can be detected and corrected as quickly as possible. The control phase accordingly consist of two parts:-

(1) Progress reporting:- (Data collection):-

The first step in progress reporting is to collect data for what is actually happening in the activity (Progress work

② Data interpretation :-

After the data has been collected, then it is necessary to interpret it by comparing the actual performance against the plan.

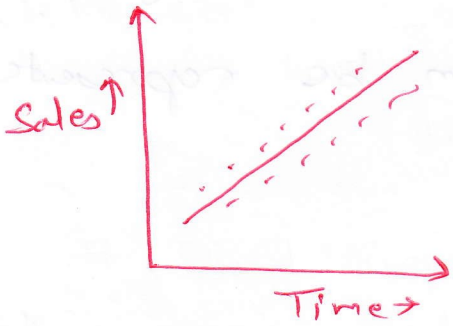
Corrective action :-

① Expediting :- If the data collected from the production unit indicates that there is significant deviation from the plan and the plan cannot be changed, then some action must be taken to get back on plan.

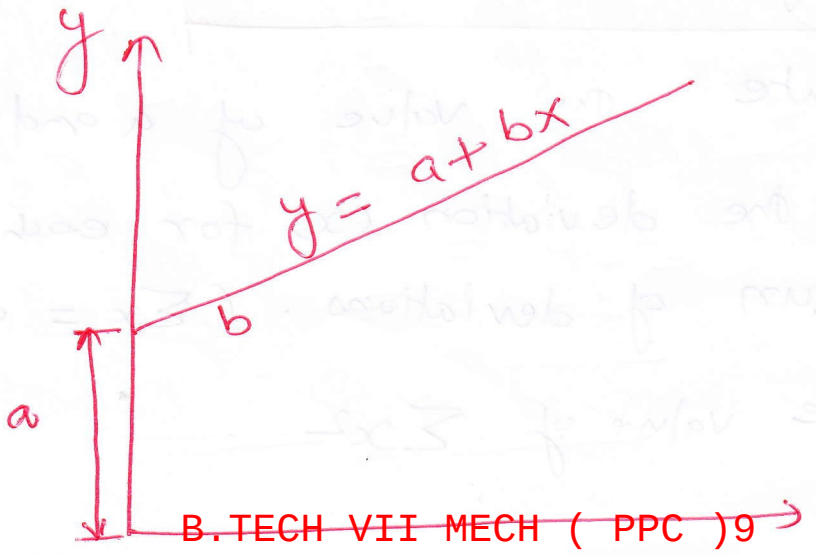
② Replanning :- It should be emphasised that the plan is not to be changed but to be followed, however, if after expediting to correct deviation it is found that, it is impossible to perform according to plan. It would be necessary to replan the whole affair. It may also be found that there were errors made while developing the original plan. In all such cases replanning is necessary.

ANSWER NO:-03 (b) TREND PROJECTION METHOD

(Regression Analysis is used for trend projection)



* → Regression means dependence and involves estimating the value of a dependent variable y, from an independent variable x.
* In simple regression, only one Independent variable is used.
* This is the mathematical method of obtaining the " the line of best fit b/n the dependent variable (Usually demand) & an independent variable. This method is called least-square method.



In simple regression analysis, the relationship b/n the dependent variable y and independent variable x can be represented by a straight line

$$y = a + bx$$

where y = dependent variable

x = independent variable

a = constant (intercept)

b = slope of line (trend)

The value of constant a and b are determined by two equation

$$y = a + bx$$

$$\Sigma y = na + b\Sigma x$$

$$\Sigma xy = a \cdot \Sigma x + b \cdot \Sigma x^2$$

n = n is the number of pairs of observations made

* To compute the value of a and b

(i) Calculate the deviation (x) for each period and also sum of deviations. ($\Sigma x = 0$)

(ii) Find the value of Σx^2

(iii) Find the value of Σxy

(iv) Calculate the value of a & b

(v) make the sum of deviation $\Sigma x = 0$

Note :- (i) If the time series consist of odd No of years to make $\Sigma x = 0$, the middle value of the time series is taken as the origin.

(ii) If the time series consist of even no of years, the mid way period b/n two middle periods is taken as origin to make $\Sigma x = 0$.

Problem :- I :- The following data give the sales of the company for various years, fit the Straight line (Use Trend projection method) forecast for sales for year 1998 & 1999-

Multiplicative model is used for this;-

$$y_t = T_t \times S_t \times I_t$$

T_t = trend component

S_t = Seasonal component

I_t = Random (Irregular) component

If $S_t > 1$, it indicate above trend,

$S_t < 1$, it's indicate below the trend.

ANSWER NO-03 (A):- DELPHI METHOD

→ Delphi method is a forecasting technique applied to subjective nature of demand values.

→ Technology forecasting is an example where there is no quantitative data based on which the future technology can be predicted.

→ In this situation we will have information at various stages of technological advancement for a particular application.

→ If we closely examine the development of computer languages, the following of the order of development

(i) machine language
(ii) Assembly language (First generation language)
(iii) High level language (Second —"— —"—)
(iv) Third generation language (Dbase-III, Lotus 1-2-3 etc)
(v) Fourth —"— —"— (Oracle, Sybase, PC-focus)

→ As of now, we are fully clear about the capabilities of languages up to fourth generation languages.

→ Beyond this stage, the next level development would be clubbed under fift generation languages. but features of such languages are yet be be known.

→ If the objective is to predict the capabilities of such language, one has to use delphi method.

→ The Delphi technique was first developed by the RAND corporation.

→ In Delphi method of forecasting, several knowledgeable persons are asked to provide subjective estimates of demands or forecasts of possible advances of technology.

→ The expert may provide several opinion. Based on the opinions of the experts, a consensus will be arrived at the demand of products / advances of technology.

ANSWER NO:- 04

Year	Sales (In thousand)
1989	13
90	20
91	20
92	28
93	30
94	32
95	33
96	38
97	43

$$y = a + bx$$

$$\Sigma y = na + b\Sigma x$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2$$

Year (x)	Sale (y)	Deviation (x) (X−5)	x^2	xy
1	13	−4	16	−52
2	20	−3	9	−60
3	20	−2	4	−40
4	28	−1	1	−28
5	30	0	0	0
6	32	1	1	32
7	33	2	4	66
8	38	3	9	114
9	43	4	16	172
	$\Sigma y = 257$	$\Sigma x = 0$	$\Sigma x^2 = 60$	$\Sigma xy = 204$

$$y = a + bx$$

Eqn (i) $\Sigma y = na + b\Sigma x$

$$\Sigma y = 9a + b \times 0$$

$$257 = 9a$$

$$\boxed{a = \frac{257}{9} = 28.55}$$

Eqn (ii) $\Sigma xy = a\Sigma x + b\Sigma x^2$

$$204 = 28.55 \times 0 + b \times 60$$

$$b = \frac{204}{60} = 3.4$$

$$y = a + bx$$

$$y = 28.55 + 3.4x$$

Sale for year 1998 $(x) = 10 - 5 = 5$

$$y_{(1998)} = 28.55 + 3.4 \times 5$$

$$= 45.55 \text{ or } 45550 \text{ Ans}$$

$$y_{(1999)} = x = 11 - 5 = 6$$

$$28.55 + 3.4 \times 6$$

$$= 48.95 \text{ or } 48950 \text{ Ans}$$

ANSWER N0:- 06

Example:- A turning department wants to install enough automatic lathes to produce 250,000 good components per year. The turning operation takes 1.5 minutes per component. But it is observed that the output of lathes will have 3% defectives. How many lathes will be required, if each one is available for 2,000 hours of capacity per year?

Soln:- Required system capacity = $\frac{\text{Actual goods components required}}{\text{System efficiency}}$

$= \frac{250000}{0.97}$

$= 257732$ components per year

$= \frac{257000 \text{ components/year}}{2000 \text{ hrs per year}}$

$= 129$ units/hr

Individual lathe capacity = $\frac{60 \text{ min per hr}}{1.5 \text{ min per component}}$

$= 40$ components per machine hour

$$\text{Number of lathes required} = \frac{129 \text{ units per hr}}{90 \text{ units per m/c hr}}$$

$$= 3.2 \text{ machines}$$

or 4 lathe machine

Ans

ANSWER NO:-07

The forecast demand for T.V. printers for the next six weeks is 35, 30, 32, 38, 30 and 32. The number of orders booked at the start of the MPS planning period is 30, 40, 25, 45, 22 and 20. The inventory on hand is 40. Lead time is one week. The production lot size is 75. Prepare mps for the inkjet printer.

Sol:- The production schedule for the six weeks is show in table;-

MPS for six weeks

Weeks	1	2	3	4	5	6
Forecast	35	30	32	38	30	32
orders	30	40	25	45	22	20
closing Inventory	05	40	8	38	8	51
Mpsqty		75		75		75
Mpsshut	75		75		75	

Week-I :- Opening inventory = 40
forecast demand = 35
closing Inventory = 05

No production is required to meet one demand which is greater than the orders.

Week-2 Opening Inventory = 05

Orders = 40

We shall need to produce a lot.

Since we manufacture in lots of 75. The inventory will be 75+5 = 80

Closing inventory = 80-40 = 40

As the lead time is 1 week, we shall have to start prodn of the lot in the first week itself.

Week-3 :- Opening inventory = 40

Forecast demand = 32

Closing inventory = 40-32 = 8

No production quantity needed.

Similarly, the prodn Schedule for other week can be workout.

ANSWER NO-08

* Sequence is the order in which a number of Jobs (operations) can be assigned to a finite number of service facilities (machine/equipments)

* One of common problems is production process is allocation of Jobs on machine so as to have optimum utilization.

* Optimum utilization involves assigning n jobs to n facilities so as to maximize profit or minimize costs or processing time.

* Sequencing provides a simple procedure for optimum loading of facilities.

Parameter which adequitably describe one scheduling are as follows:-

① No of machine (say m no of machines)
② No of Jobs (say n no of Jobs)
③ Shop configration,

* To explain the procedure of sequencing, let us consider three different cases:-

(1) n Job single machine.

(1) In the system there are only two machines m_1 & m_2 and there are n jobs. Each job is to be carried out on m_1 & then m_2, i.e. the order of the machines is $m_1 - m_2$.

(2) n Jobs are to be processed on three machines in order m_1, m_2, m_3.

(3) n Jobs are to be assigned to m machines.

* Assumptions in Sequencing problems:-

(1) Only one operation is carried out on a machine at a particular time.

(2) each operation, once started, must be completed.

(3) an operation must be completed before its succeeding operation can start.

(4) a job is processed as soon as possible, but only in the order specified.

(5) processing times are independent of order of performing the operations.

⑥ the transportation time i.e., the time required to transport jobs from one machine to another is negligible.

⑦

* SCHEDULING RULES:- (Techniques for scheduling)

① SPT (Shortest processing Time):-

Sequencing one job in a way that the job with least processing time is picked up first, followed by the one with next smallest processing time and so on as SPT sequencing and achieves the following objectives;-

① minimizing mean waiting time
② minimizing mean flow time
③ minimizing mean lateness

② * LPT (Longest processing time)

③ EDD (Earliest Due Date):-

The earliest due date implies the next job to be processed is the one that has the earliest (closest) date when the finished job is promised to the client.

or

According to this rule Jobs are sequenced in order of non-decreasing due dates.

④ FCFS :- (First come first serve)

It means that the next job to be processed is the one that arrived first in the waiting line. This would be a fairness approach, particularly if one is dealing with people.

⑤ LCFS :- (Last come first served)

⑥ RAN (Random order)

⑦ CUST PR (Highest customer priority)

⑧ SET UP (Similar required setup)

⑨ Slack Time Remaining (STR) Rule
or The least slack time (LST) :-

Slack time for a job is defined as the due date of job minus its processing time. ~~Slack~~ Sequencing the job in such a way that the jobs with the least slack time are picked up first for processing, followed by the one

(10) C.R :- (Critical Ratio) :-

It consider both aspects of processing time and due date information.

(estimates the criticality of Job as)

$$CR = \frac{\text{Remaining time}}{\text{Remaining work}}$$

$$= \frac{(\text{Due date} - \text{Current date})}{\text{Remaining processing time}}$$

* Smaller the value of CR indicates the Job is more critical.
* If CR<1, indicates that the available time is not sufficient and the Job is already running late.
* If CR>1, indicates some slack is available for the Job.

(11) WSPTRule :- In single machine scheduling problem, sequencing the Job in increasing order of weighted processing time is known as weighted shortest processing time sequencing. The weighted processing time of Job is obtained by dividing its processing time by its weights.

* Objectives in scheduling :-

① Meet customer due date.

② Minimize job lateness.

③ Minimize completion time.

④ Minimize time in the system.

⑤ Minimize overtime.

⑥ Maximize machine & labour utilization.

⑦ Minimize idle time.

⑧ Minimize WIP inventory.

⑨ Minimizing total tardiness :- lateness of a job is defined as the difference between the actual completion time of the job and its due date. If lateness is positive, it is termed as tardiness. Total tardiness is the sum of tardiness over all the jobs in the set.

⑩ Minimize number of tardy jobs.

⑪ Minimize the cost of being late.

ANSWER NO:-09

Using SPT :-

Sequence by SPT	Start Time	Finish Time	Due Date	Tardiness
D	0	1	2	0
A	1	3	7	0
C	3	6	5	01
B	6	10	6	04
E	10	16	6	10

Using Due Date :-

Sequencing by Due Date	Start Time	Finish Time	Due date	Tardiness
D	0	1	2	0
C	1	4	5	0
B	4	8	6	2
E	8	14	6	8
A	14	16	7	9

Using critical Ration :- C.R for A = $\frac{7}{2}$ = 3.5 D = $\frac{2}{1}$ = 2

B = $\frac{6}{4}$ = 1.5 E = $\frac{6}{6}$ = 1

C = $\frac{5}{3}$ = 1.66

Seq. by C.R.	Start. Time	Finish Time	Due Date	Tardiness
E	0	6	6	0
B	6	10	6	4
C	10	13	5	8
D	13	14	2	12
A	14	16	2	14

(b) How many work stations will be required & what tasks are to be performed at each station?

(c) What is the line efficiency, balance delay & smoothness index for this assembly line?

Soln:-

Working min available in weeks =

$$40 \times 60 \times \text{Efficiency}$$

$$= 40 \times 60 \times \frac{92}{100} = 2208 \text{ min}$$

Production required = 1840 units

$$\text{Cycle time} = \frac{2208}{1840} = 1.2 \text{ min}$$

No of work stations required

$$= \frac{\text{Total work content}}{\text{C.T.}}$$

$$= \frac{3.3}{1.2} = 3$$

Work station	Elements	Station time	Idle time
I	1, 2, 3	0.3+0.5+0.3 = 1.1	0.1
II	4, 5, 6, 7, 8	0.2+0.2+0.1+0.4 +0.3 = 1.2	0
III	9, 10	0.8+0.2 = 1.0	0.2

Total work content = 3.3 min

Line efficiency = $\frac{3.3}{1.2 \times 3}$ = 91.67%.

B.D. = 100 − 91.67 = 8.33%.

Smoothness Index S.I. = $\sqrt{(0.1)^2 + (0^2) + (0.2)^2}$

= $\sqrt{0.05}$ = 0.224

Ans.

ANSWER NO-10

Meaning & Definition of plant layout:-

Plant layout is the most effective physical arrangement either existing or in plans of industrial facilities i.e. arrangement of machines, processing equipments & service departments to achieve greatest co-ordination & efficiency of 4 M's (Men, materials, machines & methods) in a plant.

Once the site of the plant has been decided, the next important problems before the management of the enterprise is to plan suitable layout for the plant.

According to James Lundy, "Layout identically involves the allocation of space and the arrangement of equipments in such a manner that over all operating costs are minimized.".

Need of plant layout:-

The necessity of plant layout may be felt & the problem may arise when:-

① There are design changes in the product.
② There is an expansion of the organisation.
③ There is proposed variation in the size of the dept.
④ Some new product is to be added to the existing line
⑤ New plant is to be set-up.

Objective of Good plant layout :-

A good rather an optimum layout is one which provides maximum satisfaction to all concerned. The objectives of good layout are as follow:-

① Should provide overall satisfaction to all concerned.

② Material handling & internal transportation from one operation to next is minimized & efficiently controlled.

③ The production bottlenecks & points of congestions are to be eliminated,

④ Should utilize the space most effectively, may be cubical utilization.

⑤ Should provide workers convenience, promote job satisfaction & safety for them.

⑥ Should avoid unnecessary investment of capital.

⑦ Should help in effective utilization of labours.

⑧ Should lead to increase productivity.

⑨ Should provide space for future expansion of the plant.

⑩ Should provide proper lighting & ventilation of the area of work stations.

Principles of plant layout :-

According to Muther there are six basic principles of "best layout". These are;-

1. principle of overall integration
2. principle of minimum distance
3. principle of flow
4. principle of cubic space utilization
5. principle of satisfaction & safety
6. principle of flexibility.

* **Types of layout :-** keeping in view the type of industry & volume of production, the type of layout to be selected is to be decided from the following;

1. **Product or line layout :-**

→ If all the processing equipments & machines are arranged according to the sequence of operations of a product, one layout is called product type of layout.

→ In this type of layout, only one product or one type of products is produced in an operation area.

ANSWER NO-11

Given = $C_0 = 250000$ $N = 10$ years

$S = 50000$

(I) Sinking fund method

$$= \text{Rate of depreciation} \times \frac{(C_0 - S_s) \times i}{[(i+1)^N - 1]}$$

$i = 8\%$

$$= 13805$$

Unamortized value after 5 yr $= C_0 - R.O.D. \left[\frac{(1+i)^5 - 1}{i}\right]$

$= 250000 - 80988 = 169012$

(II) S.Y.D:-

$10 + 9 + 5 + = 55$

Dep. at the end of first year $= \frac{10}{55}(200000)$

$= 36363$

$2 = \frac{9}{55} \times 200000 = 22727$

$3 = \frac{8}{55} \times 200000 = 29090$

$4 = = 25454$

$5 = = 21818$

Total dep. of 5y $= 145432 = 250000 - 145432$

$= 104568$ Ans

(III) Decling balance method

$=$ Ans $=$ 110926 Ans

ANSWER NO:-12

Let x represent the number of units

The total cost incurred in buying the component is = 2.8x —(1)

Total cost incurred in making the component In-house = 10,000 + 1.5x — (11)

At BEP, both alternatives in equal in total cost.-

$2.8x = 10,000 + 1.5x$

$\boxed{x = 7693 \text{ items}}$

The decision rules are :-

(1) If the quantity is 7693, both make or buy are equally economical.

(2) Quantity less than 7693, it is economical to buy

(3) Quantity more than 7693, it is economical to manufacture.