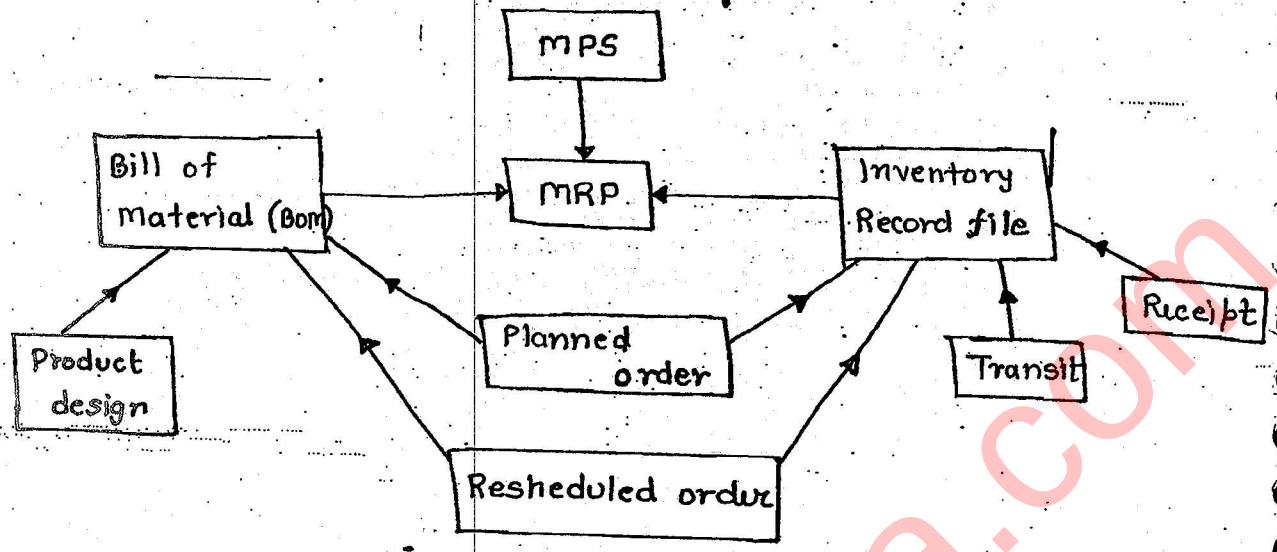
MATERIAL REQUIREMENT PLANNING (MRP)



MRP is a method of working out the production plan in a multi stage production system that produces many product and requires raw material and sub assembly. It is used to show that all the things needed should be available within the production system at an appropriate time and production can be carried out without any delay. Today MRP is a computer based information system for production, scheduling and purchasing of dependent demand item.

Master Production Schedule (MPS) is a complete time table of our scheduled prod^{n} in future. It gives information about which product is to be produced, when it is to be produced and in what quantity.

Inventory Record File :- This file gives complete and upto date information about on hand inventory, transit inventory, scheduled receipt and planned order.

Bill of Material gives information about how each final product is manufactured specifying all sub-component and their sequence of build-up in their final product.

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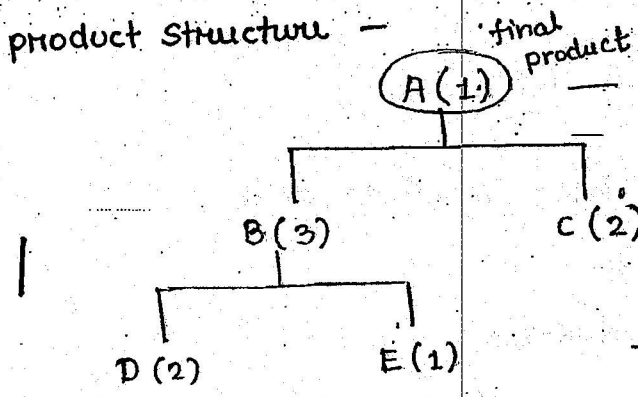
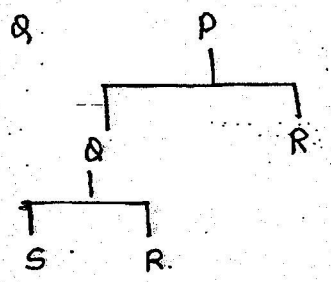
Product Structure –



Net requirement = Gross Req. – [Inventory on hand + Scheduled Recipt]



week	P	R
1	1000	2000
2	1000	2000
3	1000	2000
4	1000	2000
5	1200	2400
6	1200	2400
		2166

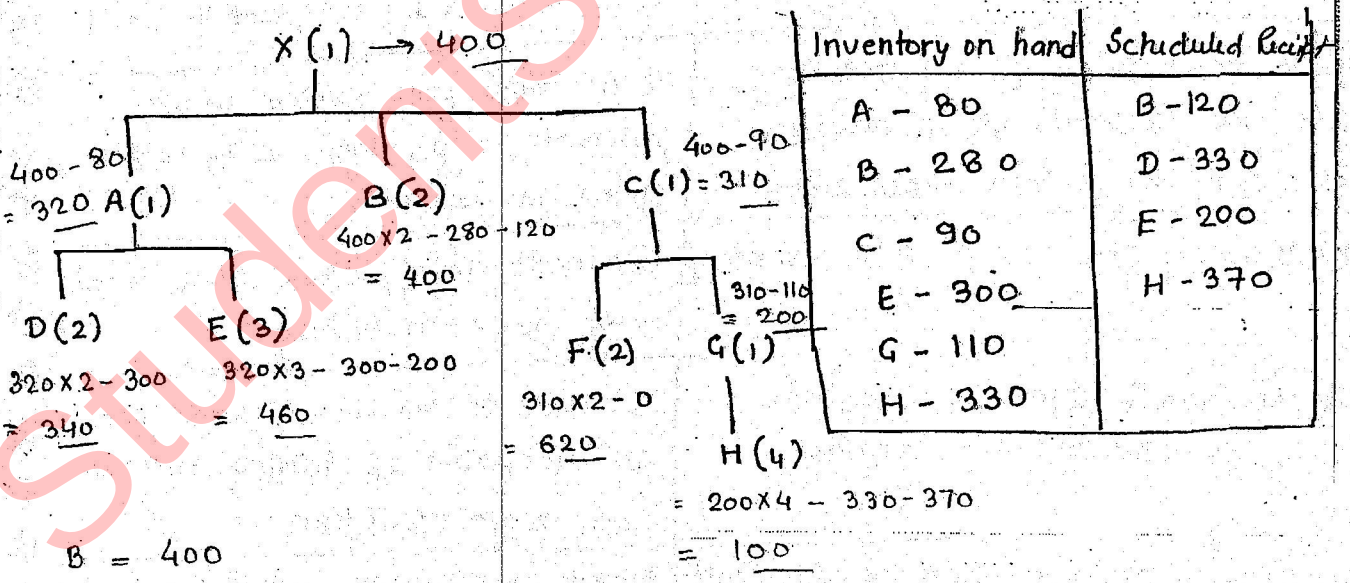
Requirement of R per week.

a) 1200 b) 2000

c) 2200 d) 2400

Q- Find the net requirement for which we should place an order in order to produce 400 units of product X when inventory on hand and scheduled Reciept is as given below –

	Inventory on hand	Scheduled Recipt
A	80	120
B	280	330
C	90	200
E	300	370
G	110	
H	330	



B = 400

D = 340

E = 460

F = 620

H = 100

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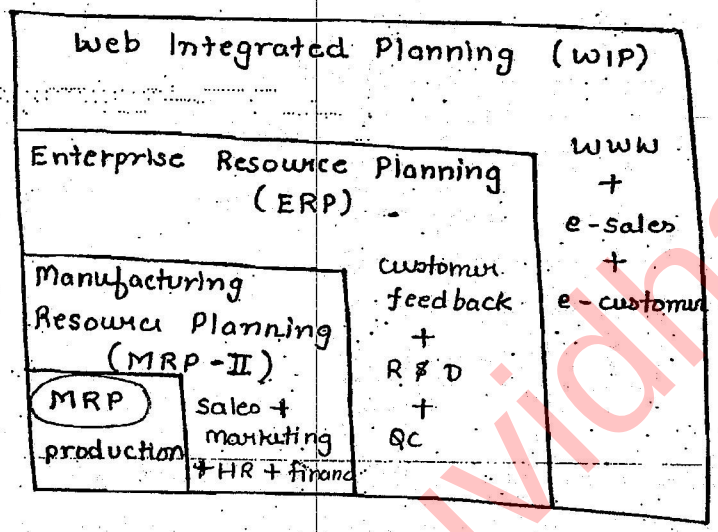
Advantages of MRP :-

i) It help us to know when and how much to order

ii) It help in inventory reduction.

iii) It helps to avoid delay in production.

iv) It gives timely information to marketting department about expected delivery time.



MRP	JIT (Just In Time)
It is from push system where product is produced in advance to meet the future requirement	It is from pull system where product is produced only when there is demand.
Keep safety stock along with inventory	Eliminate safety stock and keep very less inventory
It can handle dynamic condition where demand suddenly changes	Not able to handle dynamic condit^{n} as incapable of taking sudden and large variation
No need to maintain good relation with the vendor	Need to maintain good relation with vendor to get timely informat^{n}.
It is preferred for batch or job type product^{n}	It is preferred for mass product^{n}

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JIT → Japaneese word means card or sign

Kanban System

P-Kanban (production) | C-Kanban (conveyance)

Reliability and failure Analysis :- (Es only)

Reliability is the ability of the product to perform its main function properly for a specified period to time under the given operating conditions. A product is reliable by that we mean that it will function in the manner as expected of it. Reliability include 4 important factors -

i) Probability
ii) Time
iii) Function or performance
iv) Operating condition or environment.

Failure : The variation in the properties of a product from the desired condition is termed as failure. It represents unreliability. A product is considered to be fail when

i) It become completely inoperable
ii) when it is still operable but not able to perform
iii) when its continuous use may be not safe / unsafe.

Cause of failure -

i) defect in design
ii) improper selection of manufacturing process and technique
iii) Lack of knowledge and experience
iv) Errors during assembly
v) Improper maintenance
vi) Variation in the operating condition
vii) human error

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Types of failure :-

1) **Catastrophic (chance) failure :-**

A normal operating product suddenly become inoperative without any warning, eg - bulb.

2) **Degradation (creeping) failure :-**

It occurs gradually because of change in some parameter with time.

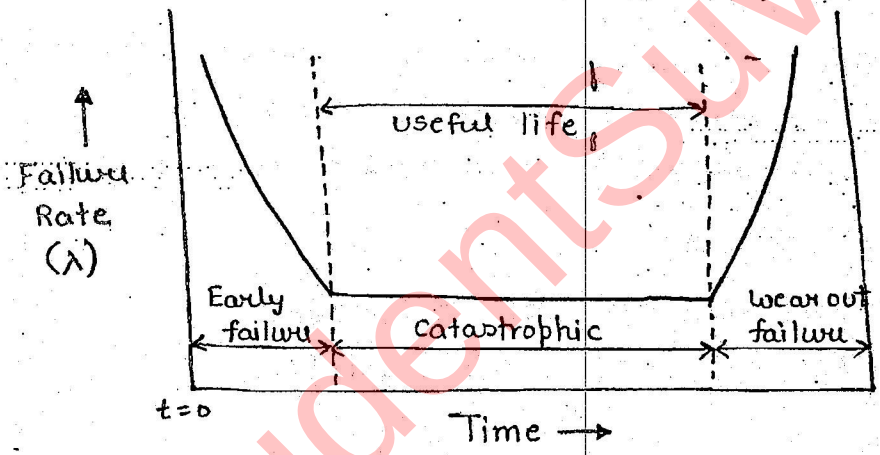
3) **Independent (primary) failure :-**

These are the failure which occur independently and does not depend upon the failure of others.

4) **Dependent (secondary) failure :-**

These product fail due to some primary failure.

Phase of Failure (Bath Tub Curve)



Early failure :- These failure occur at the beginning due to defective design, mfg or assembly work. Warranty is based on the concept of early failure.

Catastrophic :- These failure occur randomly or suddenly. These are caused due to sudden stress accumulation beyond designed limit.

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Wear out failure :- It is typical ageing problem and product will fail out due to tear and wear. Proper care and maintainence can delay the failure.

Terms related to Reliability -

Failure Rate (λ) : The no. of failures per unit time is termed as failure rate and is normally expressed in terms of failure per 100 hrs or 1000 hrs.

$$\lambda = \frac{\text{No. of failure}}{\text{Time}}$$

eg : 4000 hrs $\rightarrow$ 8 failure

$$\lambda = \frac{8}{4000} = 2 \text{ failure} / 1000 \text{ hrs}$$

Mean time between failure :- It is the time gap b/w two sucessive failure.

$$MTBF = \frac{1}{\lambda}$$

Mean time to failure :- It is the average time a product is expected to function before getting fail. It is used for those product which can not be repaired.

If $t_1, t_2, t_3, \ldots t_n$ are time to failure.

$$MTTF = \frac{\sum_{i=1}^{n} t_i}{n}$$

Reliability function (R(t)) :- It indicates the probability that the product will function over a period of time (t).

$$R(t) = \text{Prob}\{T \geq t\}$$

T is the time to failure

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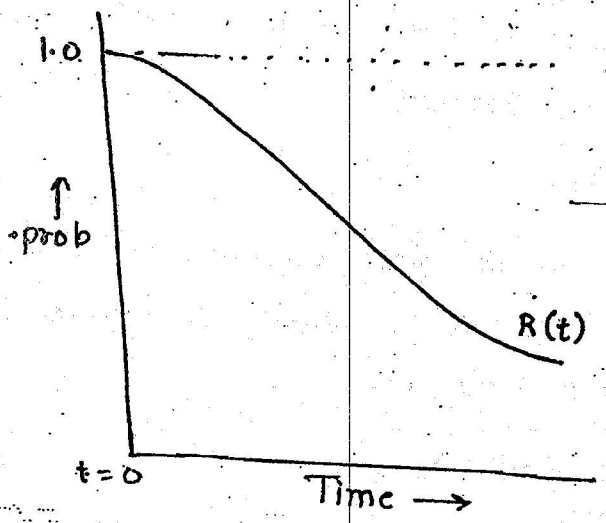


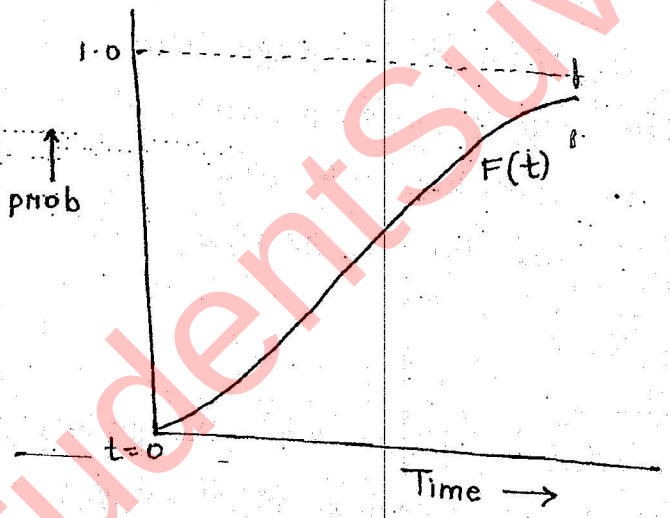
Failure function or cummulative distributive function :-

It is the probability that failure occurs before some period of time 't'.

$$F(t) = 1 - R(t)$$

$$F(t) = \text{Prob}\{T < t\}$$

T → time of failure.



Probability density function :- This function describe the shape and the area of failure distribution.

$$f(t) = \frac{d\,F(t)}{dt} = -\frac{d\,R(t)}{dt}$$

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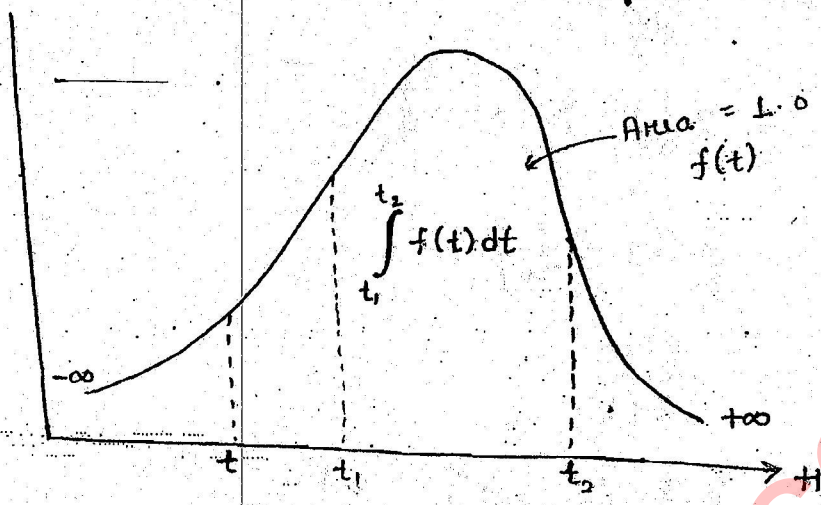
$$R(t) = \int_{t}^{\infty} f(t)\,dt$$

$$F(t) = \int_{-\infty}^{t} f(t)\,dt$$



Important Formula

1) $F(t) = 1 - R(t)$

2) $f(t) = \frac{dF(t)}{dt} = -\frac{dR(t)}{dt}$

3) $R(t) = \int_{t}^{\infty} f(t)\,dt$

4) $F(t) = \int_{-\infty}^{t} f(t)\,dt$

5) $MTTF = \int_{0}^{\infty} R(t)\,dt$

6) $\lambda(t) = \frac{f(t)}{R(t)}$

Q - The reliability of a cutting assembly is as given below. Determine -

i) Failure rate

ii) Does failure rate inc. or decrease with time

iii) MTTF.

$$R(t) = \begin{cases} \left(1 - \frac{t}{t_0}\right)^2 & 0 \le t \le t_0 \\ 0 & t \ge t_0 \end{cases}$$

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1) $f(t) = -\frac{d\,R(t)}{dt}$

$= -2\left(1-\frac{t}{t_0}\right)\times -\frac{1}{t_0}$

$= \frac{2}{t_0}\left(1-\frac{t}{t_0}\right)$

$\lambda(t) = \frac{f(t)}{R(t)}$

$= \frac{2}{t_0}\left(1-\frac{t}{t_0}\right)\cdot\frac{1}{\left(1-\frac{t}{t_0}\right)^2}$

$= \frac{2}{t_0}\times\frac{t_0}{t_0-t} \Rightarrow \frac{2}{t_0-t}$

2) At $t = 0$, $\lambda(t) = \frac{2}{t_0}$

At $t = t_0$, $\lambda(t) \Rightarrow \infty$

failure rate is increasing with time.

3) $MTTF = \int_0^\infty R(t)\,dt$

$= \int_0^\infty \left(1-\frac{t}{t_0}\right)^2 dt$

$\int_0^\infty \left(1+\frac{t^2}{t_0^2}-\frac{2t}{t_0}\right) dt$

$= \left[t+\frac{t^3}{3t_0^2}-\frac{2t^2}{2t_0}\right]_0^\infty$

$= \frac{t_0}{3}$

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System Reliability

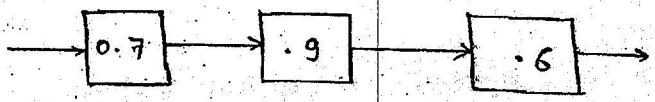
i) Component connected in series :-

$$R_S \leq \min \{R_i\}$$

$$R_S = R_1 . R_2 . R_3 \ldots\ldots R_n$$

For the sucessful operation of the system all the component connected in series must be working.

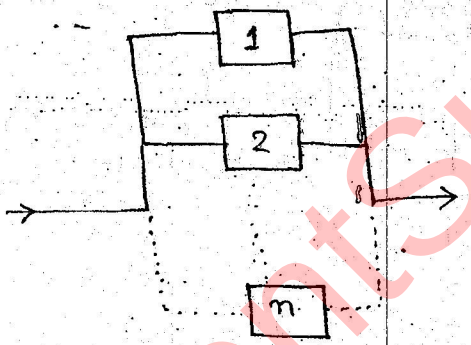
for eg -



$$R_S = 0.7 \times 0.9 \times 0.6$$

$$= 0.378$$

ii) Component connected in parallel :-

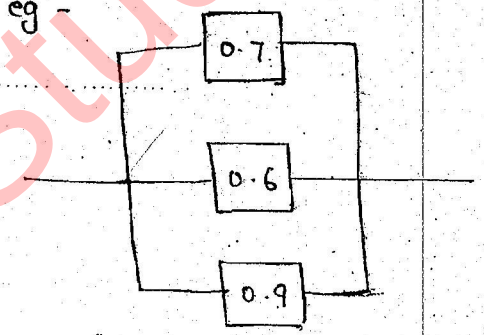


$$R_S \geq \max \{R_i\}$$

$$R_S = 1 - [(1 - R_1)(1 - R_2) \ldots (1 - R_n)]$$

For the sucessful operation of the system any one component in parallel must be working.

for eg -



$$R_S = 1 - [0.3 \times 0.4 \times 0.1]$$

$$= 0.988$$

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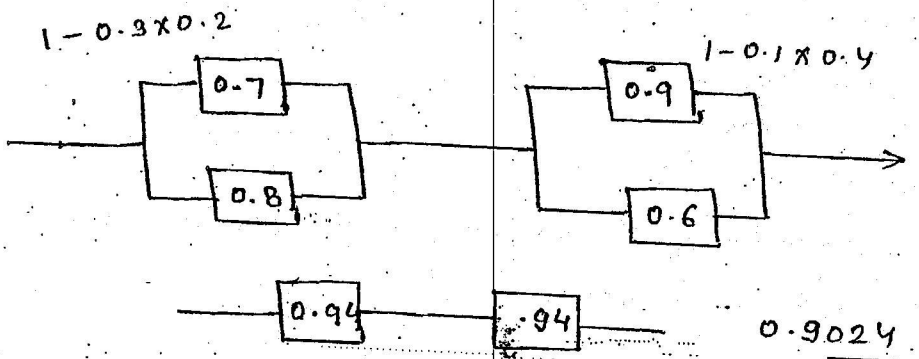
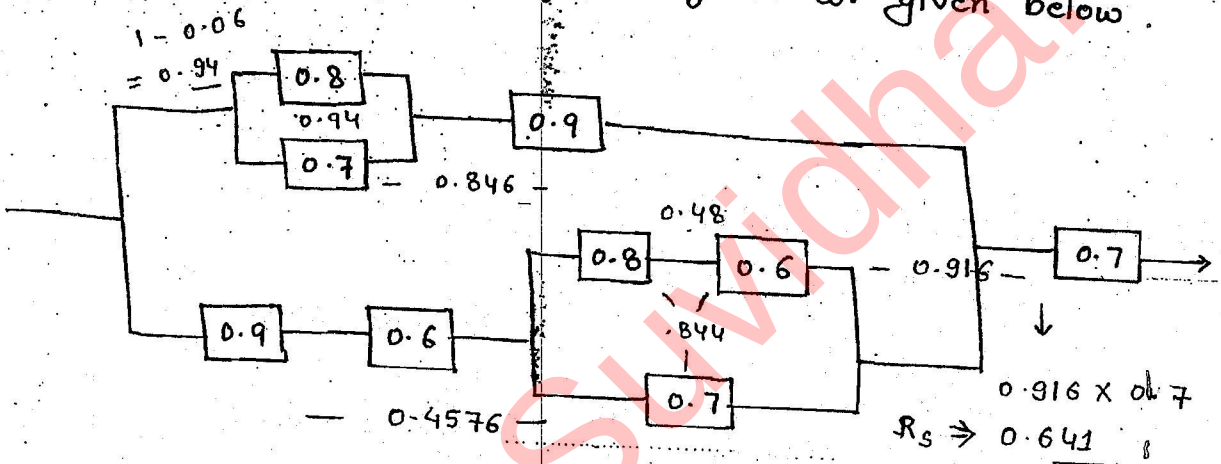
iii) Combined Series parallel System :-

The reliability of the system is analysed by converting them into equivalent sub system.



Q- Find the reliability of the system as given below.



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