## Paper – 9: OPERATIONS MANAGEMENT AND INFORMATION SYSTEMS

### Section I: Operation Management

**1A)** Choose the most correct alternative:( Answer given in **Bold**)

i) Application of technology or process to the raw material to add use value is known as :

(a) Product.

**(b)Production.** (**Note:** It is the act of making products (goods and services) through application of technology or process.)

(c) Technology.

(d) Combination of technology and process.

ii) In production by service, product undergoes the changes in:

(a) Shape and size of surface.

(b)Shape of surface only.

(c) Size of surface only.

**(d) Chemical and mechanical properties.** (**Note:** In production by service, the chemical and mechanical properties are improved without any physical change, for e.g. heat treatment process)

iii) The activity of specifying when to start the job and when to end the job is known as:

**a) Scheduling (Note:** In manufacturing, the purpose of scheduling is to minimize the production time and costs, by telling a production facility when to make, with which staff, and on which equipment.)

b)Follow-up.

c) Planning.

d)Timing.

iv)Most suitable layout for job production is :

(a) Line layout.

(b) Matrix layout.

**(c)Process layout**(**Note:** In process layout the machines of similar category are grouped together. In job production the operation differs from product to product. So, it is desirable to arrange the machines on the basis of process rather than on the products.)

(d) Product layout.

v)Aesthetic  quality of product refers to:

(a)Performance of the product.

(b) Operation of the product.

**(c)Physical appearance of the product. (Note:** The qualities that make a product attractive to look at, or pleasing to experience, determine its aesthetic appeal.)

(d)Cost of the product.

vi)Length of active life of the product is known as :

(a) Life of the product.

(b) Usefulness of the product.

**(c) Durability of the product. (Note:** Durability is a transcendent, product based, user based, manufacturing based, and value based concept. It is the degree to which a product tolerates stress or trauma without failing.)

(d)Dependability of the product.

vii)The following method is used for forecasting for new products:

**(a) Direct survey method**(**Note:** In this method potential customers are contacted personally and information they expect from the product is collected.)

(b) Method of inspection.

(c) Scattered diagram method.

(d)Seasonal Index method.

viii)The PQR classification of inventory depends on :

(a)Unit price of the material.

(b)Annual consumption value of material.

(c)Criticality of material.

**(d)Shelf life of material.** (**Note:** Inventory is classified on basis of their perishability in PQR classification.)

ix) Relaxation Allowances are considered in:

**(a)Time Study.(Note:** RA provides the worker with an opportunity to recover from the physiological and psychological effects of expending energy in the performance of specified work under specific conditions and to allow attention to personal needs.)

(b)Method Study.

(c)Ergonomic Study.

(d)Feasibility  Study.

x) The deviations of work centre time and cycle time for five work centres  on an assembly line are 0,10,10, 10 and 40 minutes. Smoothness Index will be:

(a)1900

(b)70

**(c)43.59 (Note:** Smoothness  Index $=\sqrt{(0)^2 +(10)^2+(10)^2+(10)^2+(40)^2} =\sqrt{1900} =43.59$)

(d)8.37

B) Fill in the blanks with appropriate word/words. (Answer in **bold**)

i) --------------is the interval between placing an order for a particular item and its actual receipt.(**Lead time . Note:** A lead time is the latency (delay) between the initiation and execution of a process).

ii) Product is combination of potential utilities for a --------------.(**consumer. Note:** A consumer always identifies a product in relation to its uses.)

iii) Average time per cycle declines-----------------with number of cycles.(**exponentially. )**

iv) Labour Rate Variance is Actual Rate minus Standard Rate  multiplied by ---------hours.(**Actual . Note:** This variance measures any deviation from standard in the average hourly rate paid to direct labor workers.)

v) VED analysis is carried out for ------------- control.(**spares. Note:** The VED analysis is done to determine the criticality of an item and its effect on production and other services. It is specially used for classification of spare parts.)

vi) Jigs are used in machine tool for holding------------(**tools. Note:** A jig is a type of custom-made tool used to control the location and/or motion of another tool. A jig's primary purpose is to provide repeatability, accuracy, and interchangeability in the manufacturing of products.)

vii) Method Study should ----------- work measurement. (**precede. Note:** *Method study* is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of approaching the quickest and best method of performing the work.)

viii)Despatching is toughest in ------------ production.(**batch. Note:** Finding optimum batch quantity is difficult.)

ix) Free float is ----------------- less slack time of the head event.(**total float**)

x)Case hardening increases --------------- hardness. (**surface. Note:** Case hardening or surface hardening is the process of hardening the surface of a metal object while allowing the metal deeper underneath to remain soft, thus forming a thin layer of harder metal called the "case" at the surface. )

2 A) Match each item in **Column A** with appropriate item in **Column B**:

| Column A | Column B |
| --- | --- |
| i)Assembly Line | a)Forgings |
| ii) Failure Analysis | b)Quality Control |
| iii)Consumer's risk | c)Sugar Industry |
| iv)Pickling | d)Labour Cost |
| v)Learning curve | e)Henry Ford |
| vi)Prioritisation | f) Inventory Control |
| vii)Mortality Curve | g) Maintenance System |
| viii)Smithy | h)Meredith & Gibbs |
| ix)Baggase | i)FCFS |
| x) Pareto Analysis | j)Surface Treatment |

Ans:  i   - e

ii   - g

iii  - b

iv   - j

v    - d

vi   - i

vii  - h

viii - a

ix   - c

x    - f

B) Expand the following acronyms:

i)SDE- Scarce , Difficult and Easy to Procure.

ii)BEA- Break- even Analysis.

iii)MRO-Maintenance, Repair and Operation.

iv)TEE- Total Equipment Effectiveness.

v)AIQ- Average Incoming Quality.

vi) *poLCA*: Polytomous variable Latent Class Analysis.

vii)RCCP- Rough Cut Capacity Plans.

viii)PFA- Production Flow Analysis.

ix) ) 5 S- Seiri, Seiso, Seiton, Seiketsu, Shisuke.

x) DS/RO-Dynamic Slack per Remaining Operation.


C) Indicate whether the following statements are **True**/**False.**

i) Preventive maintenance is useful in reducing inspection cost.(**False. It helps in reducing shutdown cost.**)

ii)Crude oil is example of production by disintegration. (**True. Crude oil is disintegrated into various fuel oils.** )

iii) Annealing involves heating and cooling operations.  (**True. Annealing, in** metallurgy **and** materials science**, is a** heat treatment **that alters a material to increase its** ductility **and to make it more workable. It involves heating material to above its** critical temperature**, maintaining a suitable temperature, and then cooling.**)

iv) The effective capacity is influenced by forecasts of supply.(**False. It is influenced by forecasts of demand.**)

v) Lathe is a special purpose machine.(**False. It is a general purpose machine**.)


vi) Centrifugal pumps convert electrical   energy into hydraulic energy.(**False. Centrifugal pumps convert mechanical energy into hydraulic energy**.)

vii) Human Resource Planning is balancing human resources acquired and required in an organization.(**True. Human resources planning is a process that identifies current and future human resources needs for an organization to achieve it goals. Human resources planning should serve as a link between human resources management and the overall strategic plan of an organization**.)


viii) Lathe is a special purpose machine.(**False. It is a general purpose machine**.)


ix) No  handling is best  handling.(**True. Here handling cost is nil.**)

x) 'Z' chart is a chart used in Cost control. (**False. 'Z' chart is a chart used in Program Control**)


3 A)S Manufacturing Ltd is considering expansion of solid –propellant manufacturing process by adding one ton capacity curing furnaces. Each batch (one ton) of propellant must undergo 30 minutes of furnace time, including load and unload operations. However furnace potential use factor is only 80% due to flow  restrictions in other parts of the system. Required output for the new layout is to be 16 tons per shift(8 hours). Plant(system) efficiency is estimated at 50% of capacity.

i)Determine the number of furnaces required.
ii)Estimate the percent of time the furnaces will be idle.

B) HB Timber Works uses forklift trucks to transport lumber from factory to a storage area 0.3 km away. The lift trucks can move three loaded pallets per trip and travel at an average speed of 8 km. per hour (allowing for loading, unloading, delays and travel). If 640 pallet loads must be moved during 8 hours shift, how many lift trucks are required? Assume single shift working and 300 working days in a year.

C) What are the material handling equipments you would choose for handling:

i) Handling crates on pallets within a factory-

ii) For movement of small components in a shop –

iii)Handling heavy machine parts within small radial distance –

iv)Feeding coal and iron in a steel plant-

v)Picking up bits of iron and steel in a scrap yard -

Ans: A) Required system capacity=Actual output/System efficiency

=16 tons/0.50

= 32 tons per day

Or 32/8= 4 tons per hour.

Individual furnace capacity = 1 ton/0.5 Hr =2 ton/hr

Furnace subsystem capacity=Individual unit capacity*potential use factor

=2 ton/hour*0.80=1.6 tons/hour

Number of furnaces required=Required system capacity/Actual output per furnace

= (4tons /hr)/(1.6 tons/hr)=2.5 furnace, say 3

ii) Percent idle time:

Total hours available/shift=3furnace@ 8hour=24 hours

Total hour actually used/shift =16 tons*.5hr/tons

=8 hours

Idle time = 16 hours

% time=16/24*100=67%.

B) Total distance travelled by fork lift truck per trip=(0.3+0.3) km=0.6 km(up and down)

No. of trips that can be made by the truck per shift=8km/0.6km*8hrs=106.66 trips/shift

∴ No. of pallet loads carried per shift by each truck=106.66*3=319.98=320

∴Total no. of fork lift trucks required for 640 pallet loads=640/320=2 fork lift trucks.

C  i) Fork-lift Truck.
    ii) Hand Trolley.

iii) Jib Crane.

iv) Belt Conveyor.

v) Electromagnet.

4 A) P, a fabricator with specialization in making steel wardrobes , made a survey to decide on the area to locate his new factory. He has found two alternative locations which suits his requirements. He has to plan to produce 1000 units in a year. Selling price of wardrobes is Rs.10,000/per unit. Fixed and variable costs relating to both the locations are:

| Location | Fixed Cost(Rs.) | Variable Cost(Rs.) |
|----------|-----------------|--------------------|
| I | 12,50,000 | 500/units |
| II | 20,00,000 | 350/units |

Calculate:

i) Production level at break even point for location I and location II.

ii)Which location should P choose to set up his unit?

iii)State the production level at which either of the locations can be selected.

iv)Which is the preferred location for production level of 1000 units?

B) Discuss the term: work simplification.'

Ans: A)Desired production capacity= 1000 units

Fixed cost at location I($FC_I$ )= Rs. 12,50,000.

Fixed cost at location I($FC_2$)=Rs. 20,00,000.

Variable cost at location I($FC_I$)=Rs. 500/unit.

Variable cost at location I($FC_2$ )=Rs. 350/unit.

Production quantity at break even point= Fixed Cost(FC)/[Selling price(SP)-Variable cost(VC)]

i) For location I,

Q(bep)= Rs. 12,50,000/(Rs.10000-Rs. 500)=1250000/9500=131.57 units , say 132 units.

For location II,

Q(bep)=Rs. 20,00,000/(Rs. 10000-Rs. 350)=20,00,000/9650=207.25 units, say 208 units.

ii) Since break even production level at location I(132 units) is less than breakeven level at location II(208 units), P will like to choose the location I for setting up the factory.

iii)The total Cost (TC) at breakeven point= Fixed Cost(FC)+Variable Cost(VC)

TR at location I= Rs. 12,50,000+500Q, where Q is the quantity of units to be produced in either locations.

$TC_I = TC_2$

Or, Rs. 12,50,000+500Q= 20,00,000+350Q

Or, 500Q-350Q=20,00,000-12,50,000.

Or,150Q        =750000

Or , Q            =5000 units.

For production of 1000 units:

$TC_1$ =1250000+1000*500=1250000+500000=Rs. 1750,000

$TC_2$ =20,00,000+1000*350=20,00,000+350,000=Rs. 2350,000

Total cost of production at location I is less than that of location II.

Therefore location I is preferred.

B) Work Simplification involves subdivision of an operation into its constituent elements in order to simplify operations and eliminate wasteful motions. It reduces fatigue and improves productivity. It covers all aspects of work, i.e., equipment , layout , procedures , methods etc.

A) The assembly line whose activities are shown in Figure (1) has an 8-minute cycle time. Draw the precedence graph and find the minimum possible number of workstations. Then arrange the work activities into workstations so as to balance the line. What is the efficiency of your line balance?

| Task | Performance Time (minutes) | Task Must Follow This Task |
|------|---------------------------|---------------------------|
| A | 5 | -- |
| B | 3 | A |
| C | 4 | B |
| D | 3 | B |
| E | 6 | C |
| F | 1 | C |
| G | 4 | D,E,F |
| H | 2 | G |
| | 28 | |

B) Define Motion Study. What are the steps involved in carrying out Motion Study.

Ans: A)

Figure (I): Four – Station Solution to the Line-Balancing Problem
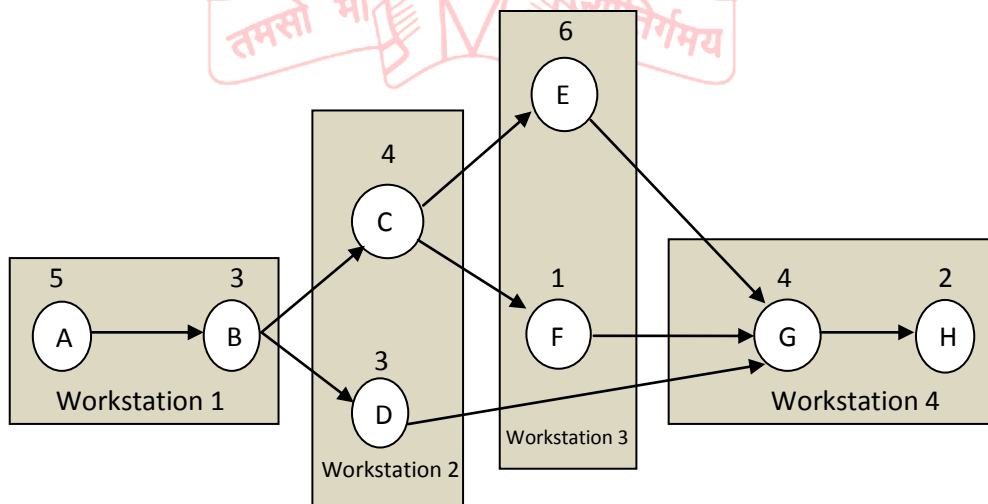
The theoretical minimum number of workstations is:

$$\frac{\sum t_i}{\text{Cycle time}} = \frac{28\,\text{minutes}}{8\,\text{minutes}} = 3.5, \text{or 4 stations}$$

The precedence graph and one good layout are shown in Figure (I)

$$\text{Efficiency} = \frac{\text{Total task time}}{(\text{Number of workstations}) \times (\text{Largest cycle time})} = \frac{28}{(4)(8)} = 87.5\%$$

B) Motion Study is a scientific and critical analysis of motions made by man or machine to perform a job so as to eliminate wasteful and unwanted motions. Steps involved in motion study are as follows:

i) Selecting the job or process to be studied keeping in view human, technical and economic factors.

ii) Breaking the job into elements and recording all facts regarding the work methods.

iii) Analysing the recorded facts so as to identify defects in existing methods. The purpose and sequence of every operation is to be critically analysed.

iv) After analyzing existing methods, developing new methods thus eliminating the defects in existing methods.

v) Defining new methods and its requirements.

vi) Installing the new method after proper training of the concerned staff.

6 A)Following is the data obtained from the Bureau of Industrial Costs and Prices. Have the prices kept pace with the rising costs?

Note 1990 = 100

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|---|---|---|
| Cost per unit of output | 203 | 216 | 223 | 239 | 248 | 253 | 279 | 301 | 311 |
| Price of final output | 225 | 242 | 250 | 271 | 275 | 277 | 295 | 318 | 329 |

B)What is expediting? What is its relevance?

Ans: A)

**Solution:**

Let us call costs as X and prices as Y as shown in the following table:

| X | Y | $x = X - \overline{X}$ | $y = Y - \overline{Y}$ | $x^2$ | xy | $y^2$ |
|---|---|---|---|---|---|---|
| 203 | 225 | - 49.6 | -50.8 | 2460 | 2520 | 2581 |
| 216 | 242 | -36.6 | -33.8 | 1340 | 1237 | 1142 |
| 223 | 250 | -29.6 | -25.8 | 876 | 764 | 666 |
| 239 | 271 | -13.6 | -04.8 | 185 | 65 | 23 |
| 248 | 275 | -04.6 | -00.8 | 21 | 4 | 1 |
| 253 | 277 | -00.4 | 1.2 | 0 | 0 | 1 |
| 279 | 295 | 26.4 | 19.2 | 697 | 507 | 369 |
| 201 | 318 | 48.4 | 42.2 | 2343 | 2042 | 1781 |
| 311 | 329 | 58.4 | 53.2 | 3211 | 3107 | 2830 |
| ∑X = 2273 | ∑Y = 2482 | | | $\sum x^2$ = 11333 | ∑xy = 10246 | $\sum y^2$ = 9393 |
| Or, $\overline{X}$ =252.6 | Or, $\overline{Y}$ =275.8 | | | | | |

For a linear regression, the coefficient of correlation between the variables X and Y is given by:

$$r = \frac{\sum xy}{\sqrt{\left(\sum x^2\right)\left(\sum y^2\right)}}$$

Where, as already noted, x = X - $\overline{X}$ and y = Y - $\overline{Y}$ .

This is called product – moment formula.

Accordingly,

$$r = \frac{10246}{\sqrt{(1333)(393)}} = \frac{10246}{10318} = 0.99$$

Therefore, there is a close correlation between costs and prices.

B) **Expediting** is a concept in purchasing and project management for securing the quality and timely delivery of goods and components.

The procurement department or an external expediter controls the progress of manufacturing at the supplier concerning quality, packing, conformity with standards and set timelines. Thus the expediter makes sure that the required goods arrive at the appointed date in the agreed quality at the agreed location.

Expediting is especially needed in large scale projects, for example, when a power plant or a refinery is erected, because a delay caused by late delivery or inferior quality will get very expensive and could lead to unsatisfied clients, thus the loss of a project. To save these unnecessary costs and minimize potential risks, the supplier and customer may agree on the use of a third party expediter. These are experts from companies specializing in this field who keep track of the deadlines, supervise progress on site and check whether the components are properly packed. After inspection they notify the involved parties and banks about their findings; if everything is as agreed the bank will initiate the transfer of the price of the goods to the supplier. In this way, the supplier secures his liquidity as he is paid immediately when the components leave his factory (letter of credit) and the customer/bank knows that the goods will be delivered correctly. Expediting is relevant for many industries, such as the oil and gas industry, the general energy industry and the infrastructure industry.

Expediting exists in several levels:

- Production control: The expediter inspects the factory whether the production is up to the standards of the country the goods are destined for. This is especially necessary for food or engineering equipment like power plant components. He controls as well whether the regular audits for ISO 9001 etc. have been made.
- Quality control: The components are tested whether they function as required and whether they are made to the measurements and standards of the customer. A part of this quality control can be the testing for compliance with standards of the destination country, e.g. ASME.
- Packing/transport survey: This is the lowest and most used level of expediting, as the goods are only counted and the packing is controlled whether it will withstand the adversities of transport (pre-shipment inspection).

- project <u>management</u>: At a large-scale project, not only goods are controlled. The expediter also keeps an eye on the deadlines and milestones of the project and whether the supplier will be on time. This way he monitors the crucial procurement parts of the project.

**Benefits of expediting:**

- Recover late product delivery at under-performing suppliers.
- Identify delivery risks and monitor production progress as it happens.
- Understand supplier capabilities and determine production bottlenecks.
- Increase flexibility for changes in workload.
- Identify opportunities, drive schedule improvements, and reduce cost.

7 A)

Fair Faces, a small-sized company making facial cosmetic powders, has mainly blenders in its plant equipment. Due to the technical characteristics (constraints) of the powders there have to be a number of such blenders accommodating small batches of the facial powders.

The main components of the operation of a blender are:

| (a) | Load talc | 2.5 minutes |
|-----|-----------|-------------|
| (b) | Add perfume | 2.0 minutes |
| (c) | Close | 0.5 minutes |
| (d) | Blend | 31.0 minutes |
| (e) | Unload into special bins | 2.2 minutes |

(Component (d) viz. 'blend' and (e) viz. 'unload into special bins' are purely machine components).

The wages of a blender-operator (i.e. the person operating) is ₹ 30/- per hour as his job involves a degree of some skill. Each load of blending generates a contribution of ₹ 50/-.

The company works on a single shift which consists of 7¼ operating hours, after allowing time for lunch, tea and personal breaks. How many blending machines should one person look after? Explain the economics involved in the operation in your answer.

B)

A work sampling study was performed on the activities of the nurses in a large private hospital. The observations are as under:

| Activity | No. of Observations |
|----------|---------------------|
| Attending to patient | 200 |
| Consulting with doctors | 50 |
| Working in the wards | 90 |
| Doing paper work | 170 |
| Reading charts | 40 |
| Talking to other nurses | 40 |
| Changing linen on beds | 60 |
| Lunch/Tex/Rest | 50 |
| Total No. of Observations | 700 |

The management of hospital plans to eliminate paper-work by acquiring an EDP system. This, it is felt, will enable the nurses' time to be better utilized. While the nurses' salary on an average is ` 3,000 per month (25 working days), the value of her time utilized (i.e. for more patient-care) is put at three times what their salary reflects. There are 150 nurses in the hospital and the EDP system is going to cost ` 50,000 a month covering the initial investment as well as operation expenses. Should the hospital go in for the EDP system?

Ans: A)
**Solution:**

One man's job (on each machine)      = (loading + adding perfume + closing)

= (2.5 + 2.0 + 0.5) min. = 5.0 min.

A machine's job = addition of **all** the component times

= 31.0 + 2.2 + 5.0 = 38.2 minutes

No. of machines per man = $\dfrac{38.2}{5.0}$ = 7.64

An operator may attend to seven to eight machines

Case 1: If the operator handles seven blending machines, he effectively works for (5.0 x 7) = 35.0 minutes and idles for 3.2 minutes for every 38.2 minutes.

The idle costs (costs of idle times) are computed as follows:

Possible blending cycles = $\dfrac{\left(7\frac{1}{4} \times 60\right)}{38.2}$

$= \dfrac{435 \text{ min.}}{38.2 \text{ min. per cycle}} = 11 \text{ cycles}$

(Note: This takes 420.2 minutes; the rest of the time i.e., 14.8 minutes cannot be utilized to make a batch)

❖ Idle time of man per day = (3.2 x 11) + (14.8) = 50.0 min.

❖ Cost of idle time of man = $\dfrac{50}{60}$ x 30 = ₹ 25 per day

❖ Idle time of machine per day = 14.8 minutes

❖ Cost of such idling = $\dfrac{14.8}{60}$ x 50 = ₹ 12.36

❖ Therefore, total costs (idling) = ₹ 25.00 + ₹ 12.36 = ₹ 37.36

Case II: If eight machines are handled by one man, the idle times of machines are 1.8 minute per 40 minutes. (Note: 5 min. x 8 = 40 min. minus 38.2 min. = 1.8 min.)

Number of Cycles = $\dfrac{435 \text{ min.}}{40 \text{ min.}}$ per cycle

= 10 cycles (+35 minutes of non-productive time)

Machine time lost = (1.8 x 10) + (35) min.

= 53 min.

Cost of such idling = $\dfrac{53}{60}$ x 50

= ₹ 44.15

Man-time lost = 35 min.

Cost of such idling = $\dfrac{35}{60}$ x 30 = ₹ 17.50

Total costs (idling) = ₹ 44.15 + 17.50 = ₹ 61.65

Since the Case I costs are lower, on this criterion, a man should look after only seven machines.

B):

As per the work sampling data, 170 out of a total of 700 observations are made for the activity 'Doing Paper-work' – i.e., the latter activity occupies 170/700 fraction of a nurse's time. This means ₹ 170/700 x (3,000) is being spent monthly per nurse on doing paperwork. For 150 nurses, this amount works out to = 170/700 x (3,000) x (150) = ₹ 1,09,286.

Notably this expenditure exceeds the amount that would be spent on the EDP system. thus, if the number of nurses could be reduced proportionate to the elimination of paper work done by them, the EDP system can be installed. This approach considers the employment of nurses as 'necessary expenditure'.

Another approach would be to look at the nurses' contribution to patent-care. If 170/700 fraction of the time is related for additional patient-care, the contribution in this area would be equivalent to:

[ (170/700) x 3 x 3,000 x (150) = ₹ 3,27,758

[ ( fraction of additionally available) x (rupee value) x ( number of nurses)

This, again, argues in favour of installing the EDP system.

8 A)

International fasteners (IF) make various types of fasteners for export to the South Asian and Russian markets. One of their production lines, producing bolts for industrial and heavy-duty use has been performing well as the sample tests during the second shift indicated in the table given below:

Sample Size = 4

| Sample No. | Bolt Diameter, cm | | | |
|---|---|---|---|---|
| 1 | 3.002 | 3.007 | 2.997 | 2.998 |
| 2 | 3.006 | 2.999 | 3.005 | 2.998 |
| 3 | 2.995 | 2.997 | 3.001 | 3.007 |
| 4 | 3.000 | 2.993 | 2.993 | 3.002 |
| 5 | 2.995 | 3.002 | 2.997 | 3.006 |

However, in the third shift, the relieving operator has not come and the second shift operator continues to operate on this line. Three of the third shift samples are as follows:

| Sample 1 | 3.007 | 2.993 | 3.013 | 2.944 |
|---|---|---|---|---|
| Sample 2 | 2.999 | 3.002 | 3.006 | 2.990 |
| Sample 3 | 2.899 | 3.008 | 3.000 | 3.006 |

Is everything in order with the process in the third shift? Explain.

B)What do you understand by 'Bench marking'?

C) What are the pros and cons of placing the quality department under operations manager?

Ans: A)

Our analysis will have to be based on the limited data available, i.e., the five samples given for the second shift. The process had been running well, i.e. it was in control, during the second shift. Well shall construct a control chart on this data. The computations are as given below.

| Sample No. | Mean, $\overline{X}$ | Range, R |
|---|---|---|
| 1 | 3.001 | 0.010 |
| 2 | 3.002 | 0.008 |
| 3 | 3.000 | 0.012 |
| 4 | 2.997 | 0.009 |
| 5 | 3.000 | 0.011 |
| | Mean of the Sample Means, $\overline{\overline{X}}$ =3.00 | Mean Range, ' $\overline{R}$ = 0.010 |

Referring to Appendix A17, for a sample size of 4, the relevant factors for our 3-sigma control charts construction are:

$$A_2 = 0.729; \quad D_4 = 2.282 \quad \text{and} \quad D_3 = 0$$

For the $\overline{X}$ chart, the 3-sigma control limits would be:

$$UCL_{\overline{X}} = \overline{\overline{X}} + A_2 \cdot \overline{R}$$

= 3.000 + (0.729)(0.010) = 3.00729 = 3.007 approximately

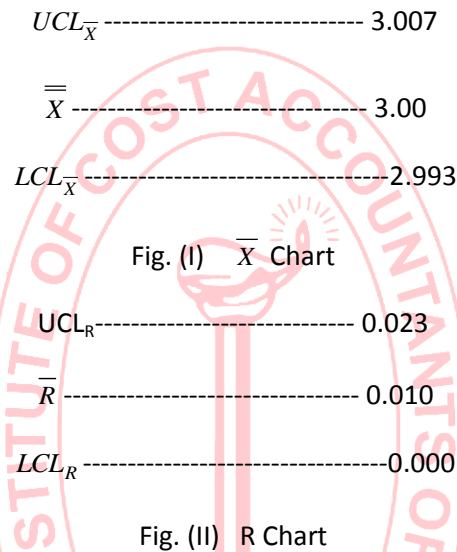$$LCL_{\overline{X}} = \overline{\overline{X}} - A_2 \cdot \overline{R}$$

= 3.000 - (0.729)(0.010) = 2.99271 = 2.993 approximately

For the R chart, the control limits would be:

$UCL_R = D_4 \cdot \overline{R}$ = (2.282) (0.010) = 0.02282 = 0.023 approximately

$LCL_R = D_3 \cdot \overline{R}$ = (0) (0.010) = 0

The control charts, are constructed, as shown in Fig. 11.16 and 11.17.

$UCL_{\overline{X}}$ ---------------------------- 3.007

$\overline{\overline{X}}$ ---------------------------- 3.00

$LCL_{\overline{X}}$ ----------------------------2.993

Fig. (I)   $\overline{X}$  Chart

$UCL_R$---------------------------- 0.023

$\overline{R}$ ---------------------------- 0.010

$LCL_R$ ----------------------------0.000

Fig. (II)   R Chart

A casual look at the third shift samples may indicate that some of the values like 3.013, 2.899, 2.990 and 3.008 cm lie outside the limits. But we must hasten to add a word of caution against making such conclusions, because the $\overline{X}$ chart pertains to a sample means only. We shall compute these as:

|  | $\overline{X}$ |
|---|---|
| Sample 1 | 3.002 |
| Sample 2 | 2.998 |
| Sample 3 | 3.001 |

The above values are very much within the control limits, so that from the viewpoint of the $\overline{X}$ chart, the process in the third shift is in control.

Let us also check the dispersion characteristics by means of the R-values. These are (for the third shift):

|  | R, cms |
|---|---|
| Sample 1 | 0.020 |
| Sample 2 | 0.016 |
| Sample 3 | 0.019 |

Again, these values are within the control limits of the R chart. Thus, the process, during the third shift, appears to be still in control.

We get the illusion of the lack of control only when we look at the individual values. In any case, it is interesting to note from this problem as to how much individual values can deviate while the process is still "in control". It shows the importance of the combined use of the $\overline{X}$ and R charts and also the limitations of depending on statistical information. For attaining excellence in quality we should strive to make each item as good as it is required to be.

B) **Benchmarking** is the process of comparing one's business processes and performance metrics to industry bests or best practices from other industries. Dimensions typically measured are quality, time and cost. In the process of best practice benchmarking, management identifies the best firms in their industry, or in another industry where similar processes exist, and compares the results and processes of those studied (the "targets") to one's own results and processes. In this way, they learn how well the targets perform and, more importantly, the business processes that explain why these firms are successful.

Benchmarking is used to measure performance using a specific indicator (cost per unit of measure, productivity per unit of measure, cycle time of x per unit of measure or defects per unit of measure) resulting in a metric of performance that is then compared to others.

Also referred to as "best practice benchmarking" or "process benchmarking", this process is used in management and particularly strategic management, in which organizations evaluate various aspects of their processes in relation to best practice companies' processes, usually within a peer group defined for the purposes of comparison. This then allows organizations to develop plans on how to make improvements or adapt specific best practices, usually with the aim of increasing some aspect of performance. Benchmarking may be a one-off event, but is often treated as a continuous process in which organizations continually seek to improve their practices.

There is no single benchmarking process that has been universally adopted. The wide appeal and acceptance of benchmarking has led to the emergence of benchmarking methodologies.

The following is an example of a typical benchmarking methodology:

- **Identify problem areas:** Because benchmarking can be applied to any business process or function, a range of research techniques may be required. They include informal conversations with customers, employees, or suppliers; exploratory research techniques such as focus groups; or in-depth marketing research, quantitative research, surveys, questionnaires, re-engineering analysis, process mapping, quality control variance reports, financial ratio analysis, or simply reviewing cycle times or other performance indicators. Before embarking on comparison with other organizations it is essential to know the organization's function and processes; base lining performance provides a point against which improvement effort can be measured.

- **Identify other industries that have similar processes:** For instance, if one were interested in improving hand-offs in addiction treatment one would identify other fields that also have hand-off challenges. These could include air traffic control, cell phone switching between towers, transfer of patients from surgery to recovery rooms.

- **Identify organizations that are leaders in these areas:** Look for the very best in any industry and in any country. Consult customers, suppliers, financial analysts, trade associations, and magazines to determine which companies are worthy of study.

- **Survey companies for measures and practices:** Companies target specific business processes using detailed surveys of measures and practices used to identify business process alternatives and leading companies. Surveys are typically masked to protect confidential data by neutral associations and consultants.

- **Visit the "best practice" companies to identify leading edge practices:** Companies typically agree to mutually exchange information beneficial to all parties in a benchmarking group and share the results within the group.
- **Implement new and improved business practices:** Take the leading edge practices and develop implementation plans which include identification of specific opportunities, funding the project and selling the ideas to the organization for the purpose of gaining demonstrated value from the process.

C) The pros and cons of placing the quality department under the Operations Manager are as follows:

PROS:

Allows close coordination required with the work force , purchasing  and production process and to this extent TQC is practicable. Everybody gets involved in quality control.

CONS:

i)The  quality function can become little more than mere inspection with proper planning for quality by separate quality control department.

ii)An independent quality department can assure that quality is not compromised to meet other aspects such as schedules or cost reductions.

  This debate can be resolved under a total quality programme where the quality department is viewed as the organizational coordinator for all other departments affecting quality e.g. marketing, personnel etc. regardless of hierarchical position .

9 A)

ABC Co. is producing and selling a variety of make-to-stock goods. Goods after production are stored in a Central Warehouse from where sales are effected. In a monthly performance review meeting of various divisions, the Finance Manager expressed concern over the excessive operational costs of warehouse. The high costs were apparently attributed to a great deal of overcrowding and congestion in the warehouse with work frequently piling up at certain times in the operation, especially during peak periods.

The Industrial Engineer of the Co. was asked to study the problem and suggest measures to reduce costs. He stated the problem as follows:

"How can we modify the material handling procedures in such a way as to reduce or eliminate the congestion, overcrowding and piling up of work and thus reduce operational costs?"

(a) As an Operations Manager, would you accept the definition of the problem by the Industrial Engineer as satisfactory or acceptable? Why?

(b) Explain in the context of systems approach, how you would spell out the problem.

(c) Also suggest possible solution/ solutions approaches to the problems identified by you in (b) above.

B)What is the basis of the social-technical view of modern organizations involved in production or operations?

A)

The problem stated by the Industrial Engineer is a narrow one and assumes that the causes of spiraling operational costs in the warehouse are within-the warehousing subsystem. Warehousing function is only a subsystem of a larger system. The efficiency and effectiveness of warehousing operations will not only be affected by their own managerial inefficiencies but also because of actions of other sub-systems with whom warehouse continuously interact. Thus warehousing function has to be viewed not as a closed system but an open system.

To solve the problem of increasing cost, 'System approach' will have to be adopted. Systems approach emphasizes that whenever an action or decision is taken to improve a subsystem, the effect of this action on other subsystems will have to be considered; likewise the repercussions of actions of other subsystems on the subsystem being studied will have to be assessed. The expected overall benefits to the entire system (in this case company as a whole) will have to be kept in sharp focus all the time.

In the way the problem has been stated by the Industrial Engineer, the options he will consider are limited like the following ones. These might include, for example, adding more warehouse space, improving the layout and/or procedures and introducing some automation. Any or all of these approaches may result in a reduction of the high costs. Yet, however brilliant the solution may be, the effectiveness of cost reduction effort has been limited by the implicit assumptions that were made concerning the nature of the cost problems.

Now let us try to broaden the assumptions to include the possibility that the flow through the warehouse actually depends largely on factors outside the warehouse. We have in a sense opened the door of our warehousing subsystem and brought into play a new set of related variables. These might include say.

   (i)   The size and shape of materials that are brought into the warehouse, their sequence and rate of delivery and withdrawal
   (ii)  Order filling and shipping procedures and
   (iii) Company's sales forecasting methods. Are these organized well in such a way to maintain the most effective flow through the warehouse?

The point here is that the new set of assumptions immediately change our statement of the cost problem. The reason is that we have now indentified the significant interactions between the warehousing subsystem and other subsystems within the organisation. In so doing, we now recognize that the causes of the high costs in the warehouse may not be solely with the functioning of the warehouse but may be largely rooted in functions outside it.

Having identified and recognized the inter-relationships among the subsystems that affect the warehousing operation, we can no longer accept any statement of the problem of interms of warehousing cost alone. If, for example, the reduction in warehousing costs led to impaired customer

service, decreased the efficiencies of handling records or in any way detracted from the total profitability of the system, then nothing would have been achieved.

Thus from systems view point, a more correct statement of the problem is as follows:

"How can we eliminate the congestion, over-crowding and work pile-up in the warehouse in such a way as to achieve an optimal balance among the objectives of reducing warehousing costs, maintain specific standards of customer service, meeting certain sales requirements and increasing the total profitability of the company".

B) **Sociotechnical systems** (**STS**) in organizational development is an approach to complex organizational work design that recognizes the interaction between people and technology in workplaces. The term also refers to the interaction between society's complex infrastructures and human behaviour. In this sense, society itself, and most of its substructures, are complex sociotechnical systems. The term sociotechnical systems was coined in the 1960s by Eric Trist, Ken Bamforth and Fred Emery, who were working as consultants at the Tavistock Institute in London.

Sociotechnical systems pertains to theory regarding the social aspects of people and society and technical aspects of organizational structure and processes. Here, technical does not necessarily imply material technology. The focus is on procedures and related knowledge, i.e. it refers to the ancient Greek term *logos*. "Technical" is a term used to refer to structure and a broader sense of technicalities. Sociotechnical refers to the interrelatedness of *social* and *technical* aspects of an organization or the society as a whole Sociotechnical theory therefore is about *joint optimization*, with a shared emphasis on achievement of both excellence in technical performance and quality in people's work lives.. They are usually based on designing different kinds of organisation, ones in which the relationships between socio and technical elements lead to the emergence of productivity and wellbeing.

Sociotechnical refers to the interrelatedness of *social* and *technical* aspects of an organization. Sociotechnical theory is founded on two main principles:

- One is that the interaction of social and technical factors creates the conditions for successful (or unsuccessful) organizational performance. This interaction consists partly of linear "cause and effect" relationships (the relationships that are normally "designed") and partly from "non-linear, complex, even unpredictable relationships (the good or bad relationships that are often unexpected.

Whether designed or not, both types of interaction occur when socio and technical elements are put to work.

- The corollary of this, and the second of the two main principles, is that optimization of each aspect alone (socio or technical) tends to increase not only the quantity of unpredictable, "un-designed" relationships, but those relationships that are injurious to the system's performance.

Socio-technical effort emphasizes the need of giving a human face to the work. Instead of making people adapt to work, it stipulates that work must be adapted to people.

10 A)

H.E.Ltd. tests its product, the colour TV tube, for 2000 hours. A sample of 100 TV tubes was put through this quality test, during which two tubes failed.

If the customers use the tube for an average of four hours per day, and if 10,000 TV tubes were sold, then in one year from their selling how many tubes tubes will be expected to fail? What is the Mean Time Between Failures (MTBF) for these tubes?

B)

M/S PQR Ltd. uses a reciprocating compressor in its plant to be cost the air pressure. Air required for the process carries with it oil from this compressor into the pipe where gases are mixed. This oil in combination with oxygen forms carbon deposits which settle in the pipe Carbon deposits constitute an explosion hazard. Consequently the pipe has to be cleaned once in two weeks. The time required for cleaning consists of cooling of the plant, disconnecting instruments, removal of pipe, cleaning, refitting of the pipe and instruments and warming up the unit. The total time required for this is 4 hours and 45 minutes. The plant produces at the rate of 1.5 ton per hour. The product fetches a profit of ₹ 100/- per ton. The cost of labour and overheads of maintenance department, amounts to ₹ 5/- per hour. A new compressor is available which would cost ₹ 10,000/-. It will reduce the frequency of cleaning to once in 4 weeks. The old compressor can be sold for ₹ 2,000/-. The company works out the cost of equipment @ 25% per annum which consists of depreciation, maintenance and interest. At present, annual capital costs is calculated to be ₹ 500/-. The decision to change the compressor is to be taken. Suppose you are the person concerned, what would be your decision?

Ans: A)

The total time of testing = (100 tubes) x (2000 h) = 2,00,000 tube-hours

However, two tubes have failed and, therefore, the real testing time is less than the total time computed above. The matter has to be adjusted for the number of testing hours lost due to the failures during the testing. These lost hours are: (assuming each of the failed tubes has lasted as average of half of test period)

= (2 tubes) x (Average of $\frac{2000}{2}$ hours for each tube)

= 2,000 tube-hours

Therefore, the test shows that there are two failures during (2,00,000 – 2,000) = 1,98,000 tube-hours of testing.

Hence, during 365 days of the year (four hours a day) for 10,000 tubes there are expected failures of:

$$\left( \frac{2}{1,98,000} \frac{\text{failures}}{\text{per}} \right) \text{X (10,000 tubes) X (365 X 4 hours)} = 147.47 = 148 \text{ approximately}$$

The mean time between failures = $\dfrac{1,98,000 \text{ tube} - \text{hours of testing}}{2 \text{ failures}}$

$= 99,000$ tube-hours per failure

$= \dfrac{99,000}{(4 \times 365)}$ tube-years per failure

$= 67.68$ tube-years per failure

B)

**Solution:**

| | |
|---|---|
| Loss of output each fortnight | = 4.75 hrs x 1.5 tons = 7.125 tons. |
| Loss of profit each fortnight | = 7.125 tons x 100 = 712.50 Rupees. |
| Cost of labour and overhead each fortnight | = 5 x 4.75 = ₹ 23.75. |
| Total cost per fortnight | = (₹ 712.50 + ₹ 23.75) = ₹ 736.25 |
| Present cost per year | = ₹ 736.25 x 26 = ₹ 19,142.50. |
| Additional capital expenses | = ₹ 10,000 – ₹ 2,000 = ₹ 8,000/- |
| Capital cost per year | = ₹ 8,000 x 0.25 = ₹ 2,000/- |
| Present capital cost per year | = Rs 500/- |
| Additional annual capita cost | = ₹ 1,500/- ds |
| Annual cost of cleaning after change of compressor | = 736.25 x 13 = ₹ 9,571.25 |
| Annual Savings | = 19,142.50 – 9,571.25 = ₹ 9,571.25 |
| Net annual savings | = 9,571.25 – 1,500 = ₹ 8,071.25/- |

Therefore, it is economical to change the compressor.

11 A)
BFP Limited produces a special fiber at the rate of 5,000 meters per hour. The fiber is used in the other products made by Bharati, at the rate of 20,000 meters per day (in the 8-hour day). The cost of fiber is ₹ 5 per meter. The inventory carrying cost is 25 per cent and the set-up costs are = ₹4,050 per set-up. Compute the optimal number of cycles required in a year for the manufacture of this special fiber.

B)
The WWF Computer Ltd. purchases 8,000 transistors each year as components in minicomputers. The unit cost of each transistor is = ₹ 500, and the cost of carrying one transistor in inventory for a year is = ₹150. Ordering cost is = ₹ 1,500 per order.

What are (a) the optimal order quantity, (b) the expected number of orders placed each year, and (c) the expected time between orders? Assume that Fisher operates on a 200-day working year.

C) Draw a comparison between 'Type Grouping' and 'Sequence Grouping' of machines in a factory.

Ans: A)

Rate of production,                  p = 5000 m/h

Rate of usage,                       r = $\dfrac{20,000}{8}$ = 2500 m/d

s == ₹ 5 per m., f = 0.25, C$_o$ = = ₹ 4050 per set-up

A = 20,000 x 365 per year

$$EBQ = Q_{opt} = \sqrt{\dfrac{2C_o A}{s.f.(p-r)/p}}$$

$$\sqrt{\dfrac{2 \times 4050 \times 20,000 \times 365}{5 \times 0.25 \times (5000 - 2500)/5000}} = 3,07,584 \text{ m}$$

Optimal number of cycles $\dfrac{A}{Q_{opt}} = \dfrac{20,000 \times 365}{3,07,584}$ = 23.7 cycles = 24 cycles

B) Q* = $\sqrt{\dfrac{2DS}{H}} = \sqrt{\dfrac{2(8,000)(1500)}{150}}$ = 400 units

   (a)  N = $\dfrac{D}{Q*} = \dfrac{8,000}{400}$ = 20 orders

   (b)  Time between orders = T = $\dfrac{\text{Number of working days}}{N} = \dfrac{200}{20}$ = 10 working days

With 20 orders placed each year, an order for 400 transistors is placed every 10 working days.

C) The differences between Type and Sequence Grouping of machines are as follows:

| Aspect | Type Grouping | Sequence Grouping |
|---|---|---|
| 1)Investment | Comparatively lower, due to higher capacity utilization. | Higher, as some machines in the line may remain partly utilized. |
| 2)Flexibility | Better in terms of processing new equipment. | Less flexibility in coping up with changes in the product or process. |
| 3)Breakdowns | Failure of machine does not stop production flow. | Breakdown of one machine disrupts flow and may stop the entire line. |
| 4) Throughput time. | Higher due to waiting time involved. | Lower. |
| 5)In process Inventory. | High | Low. |
| 6)Production Control | Difficult and needs continuous monitoring. | Simple. |

| 7)Supervision | High | Low |
|---|---|---|
| 8)Material movement | More often high due to criss-cross movements. | Material moves in predetermined routes and hence less movement. |

12 A) A defense contractor in New Delhi has six jobs awaiting processing. Processing time and due dates are given in the table. Assume that jobs arrive in the order shown. Set the processing sequence according to FCFS and SPT and evaluate.

| JOB | JOB PROCESSING TIME (DAY) | JOB DUE DATE ((DAYS) |
|---|---|---|
| A | 6 | 22 |
| B | 12 | 14 |
| C | 14 | 30 |
| D | 2 | 18 |
| E | 10 | 25 |
| F | 4 | 34 |

B)

Jobs waiting to be processed at the Milling shop today (the July 23) are as follows:

| Job | Due Date | Estimate of Time Needed* to Complete the Job (days) |
|---|---|---|
| A | July 31 | 9 |
| B | Aug. 2 | 6 |
| C | Aug. 16 | 24 |
| D | July 29 | 5 |
| E | Aug. 30 | 30 |

(*Note: Counting from today.)

Sequence the jobs at the Milling shop based on minimum critical ratio.

Ans: A)

❖ FCFS has the sequence A-B-C-D-E-F.

| JOB SEQUENCE | JOB PROCESSING TIME | FLOW TIME | DUE DATE | JOB LATENESS |
|---|---|---|---|---|
| A | 6 | 6 | 22 | 0 |
| B | 12 | 18 | 14 | 4 |
| C | 14 | 32 | 30 | 2 |
| D | 2 | 34 | 18 | 16 |
| E | 10 | 44 | 25 | 19 |
| F | 4 | 48 | 34 | 14 |
| | 48 | 182 | | 55 |

(i) Average completion time = 182/6 = 30.33 days

(ii) Average number of jobs in system = 182/48 = 3.79 jobs

(iii) Average job lateness = 55/6 = 9.16 days

(iv) Utilization = 48/182 = 26.4%

❖ SPT has the sequence D-F-A-E-B-C.

| JOB SEQUENCE | JOB PROCESSING TIME | FLOW TIME | DUE DATE | JOB LATENESS |
|---|---|---|---|---|
| D | 2 | 2 | 18 | 0 |
| F | 4 | 6 | 34 | 0 |
| A | 6 | 12 | 22 | 0 |
| E | 10 | 22 | 25 | 0 |
| B | 12 | 34 | 14 | 20 |
| C | 14 | 48 | 30 | 18 |
| | 48 | 124 | | 38 |

(i) Average completion time = 124/6 = 20.67 days

(ii) Average number of jobs in system = 124/48 = 2.58 jobs

(iii) Average job lateness = 38/6 = 6.33 days

(iv) Utilization = 48/124 = 38.7%

SPT is superior to FCFS in this case on all four measures. If we were to also analyze EDD, we would, however, find its average job lateness to be lowest at 5.5 days. SPT is a good recommendation. SPT's major disadvantage is that it makes long jobs wait, sometimes for a long time.

B) The necessary calculations are done as per the following table.

| Job | Due Date | Time Remaining for Due Date of the Job, in days (TR) | Estimate of Time Needed to Complete the Job (days) | Critical Ratio = TR/TN |
|---|---|---|---|---|
| A | July 31 | 8 | 9 | 8/9=0.89 |
| B | Aug. 2 | 10 | 6 | 10/6=1.67 |
| C | Aug. 16 | 24 | 24 | 24/24=1.00 |
| D | July 29 | 6 | 5 | 6/5=1.20 |
| E | Aug. 30 | 38 | 30 | 38/30=1.27 |

Job A has the lowest Critical Ratio and has to be processed first, while Job B has the largest Critical Ratio and is scheduled the last. The entire sequence is:

A, C, D, E, B

(Note: A CR value of less than 1.00 means that the job is already late and if it is to be delivered on schedule, the process times and/or transport times and/or wait times have to be reduced – i.e., the job needs to be expedited.)

A CR value of 1.00 indicates that the job is on schedule; that greater than 1.00 shows that the job has some slack available to it.)

13 A)

Following data relates to a work sampling study of a long cycle non-repetitive operation:

| (a) | Total Time Study | = 10 days. |
|-----|------------------|-----------|
| (b) | Total number of observations | = 1200 |
| (c) | Observation of Productive activity | = 900 |
| (d) | Manually controlled elements | = 600 |
| (e) | Machine controlled elements | = 300 |
| (f) | Total acceptable units produced | = 4000 pieces. |
| (g) | Average rating index | = 110% |
| (h) | Observations of unavoidable delay | = 100 |

Calculate the standard time

B) Mention in brief, the 'allowances ' used in work measurement and their scope.


C)

A work operation consisting of three elements has been subjected to a stopwatch time study. The recorded observations are shown in the following table. By union contract, the allowance time for the operation is personal time 5%, delay 5%, and fatigue 10%. Determine the standard time for the work operation.

Observations (minutes)

| Job Element | 1 | 2 | 3 | 4 | 5 | 6 | Performance Rating (%) |
|------------|-----|-----|-----|-----|-----|-----|------------------------|
| A | 0.1 | 0.3 | 0.2 | 0.9 | 0.2 | 0.1 | 90 |
| B | 0.8 | 0.6 | 0.8 | 0.5 | 3.2 | 0.7 | 110 |
| C | 0.5 | 0.5 | 0.4 | 0.5 | 0.6 | 0.5 | 80 |

Ans: A)

Assumptions:

(i)     The number of observations is sufficient to attain the desired accuracy and confidence level.

(ii)    The process is assumed to be within control.

(iii)   The study was conducted during working hours at the rate of 6 hours per day (of 8 hours).

(iv)    No over time is permitted.

(v)     Total time during which the study was conducted = 60 hours.

Productive time percentage = $\left(\dfrac{900}{1200}\right)$ x 100 = 75%

Productive time = 60 x 0.75 = 45 hours = 45 x 60 = 2700 minutes.

Time per piece = $\dfrac{2700}{4000}$ = 0.675 minutes.

Manually controlled elements = 600 observations.

Manually controlled time = $\dfrac{0.675 \; x\, 600}{900}$ = 0.450 minutes.

Machine controlled time = 0.675 − 0.450 = 0.225 minutes.

Basic time per unit = (0.450 x 1.10) + 0.225 = 0.721 minutes.

Unavoidable delay time = $\left(\dfrac{100}{1200}\right)$ x 100 = 8.3%

Hence allowance to be provided = (0.083 x 0.750) x 100 = 11%

Therefore, standard time  = 0.721 + 0.11 x 0.721 = 0.721 + 0.07931

= 0.8 minutes approximately.

B) Work measurement is the application of techniques designed to establish the time for a qualified worker to carry out a specified job at a defined level of performance.

The work content of a job or operation is defined as: basic time+ relaxation allowance+ any allowance for additional work (e.g. the part of relaxation allowance that is work related).

Standard time is the total time in which a job should be completed at standard performance – i.e. work content, contingency allowance for delay, unoccupied time and interference allowance.

The 'allowances' are as follows:

i)**Personal and fatigue allowances**: Personal and fatigue allowance is an addition to the basic time intended to provide the worker with the opportunity to recover from the physiological and psychological effects of carrying out specified work under specified conditions and to allow attention to personal needs. Obviously this is a function of the efforts exerted and the working environment and the quantum has to be decided through ergonomic researches. The amount of the allowance will depend on the nature of the job.

Personal and fatigue allowances constitute the major addition to the normal times to arrive at the standard time and usually  given as percentages of the basic times under the heading 'personal and rest allowance' or simply 'relaxation allowance'. Typical values of relaxation allowance are 12-20%.

ii) **Contingencies:** A contingency allowance is a small allowance of time which may be included in a standard time to meet legitimate and expected items of work or delays, precise measurement of which is uneconomical because of their infrequent or irregular occurrence. This allowance takes care of minor interruptions in work such as tool adjustments, tool breakage, getting advice from supervisors, minor breakdowns, etc. The quantum should be decided by shift or work sampling studies for a sufficiently long duration. Contingency allowance should not be more than 5%, and should only be given where the contingencies cannot be eliminated and are justified.

iii) **Special allowances :** These cover allowances provided for specific situation usually temporary e.g learning allowance for trainee operators. A policy allowance is sometimes provided by management decisions to ensure a certain level of earnings for the workers. It is added to time standards for computing incentive earnings but does not constitute a part of them.

C)

First, delete the two observations that appear to be very unusual (09) minute for job element A and 3.2 minutes for job element B).

Then:

A's average observed time = $\dfrac{.1+.3+.2+.2+.1}{5}$ = .18 min

B's average observed time = $\dfrac{.8+.6+.8+.5+.7}{5}$ = .68 min

C's average observed time = $\dfrac{.5+.5+.4+.5+.6+.5}{6}$ = .50 min

A's normal time = (.18)(.90) = .16 min.

B's normal time = (.68)(1.10) = .75 min.

C's normal time = (.50)(.80) = .40 min.

Normal time for job = 0.16 + 0.75 + 0.40 = 1.31 min

Note, the total allowance factor = .05 + .05 + .10 = .20

Then: Standard time = $\dfrac{1.31}{1-.20}$ = 1.64 min

14 A) A machine shop has a press which is to be replaced as it wears out. A new press is to be installed now and an optimum replacement plan is to be for next 7 years after which the press is no longer required. Following data is available:

Rs in '000

| Years | Cost of new machine | Salvage value | Operating cost |
|-------|--------------------|--------------|----------------|
| 1 | 500 | 250 | 150 |
| 2 | 525 | 125 | 200 |
| 3 | 550 | 75 | 250 |
| 4 | 600 | 50 | 300 |
| 5 | 650 | 40 | 375 |
| 6 | 725 | 25 | 450 |
| 7 | 800 | 0 | 575 |

Find the optimum replacement policy.

B)
An Electronic Data Processing (EDP) centre has three expert software professionals. The Centre wants three application software programs to be developed. The head of EDP Centre estimates the computer time in minutes required by the experts for development of Application Software Programs as follows:

| Software Programs | Computer time (in minutes) required by Software Professionals | | |
|-------------------|------|------|------|
| 1 | 100 | 85 | 70 |
| 2 | 50 | 70 | 110 |
| 3 | 110 | 120 | 130 |

Assign the software professionals to the application software programs to ensure minimum usage of computer time.

C) Differentiate between:

i) Job Analysis and Value Analysis.

ii) Stock turnover and labour turnover.

Ans: A) Using the given information, the minimum annual cost is computed in the following table:

Rs in '000

| Year(t) | Operating Cost $\sum[f(t)]$ | Salvage value[S(t)] | Cost of new machine(C) | Total cost C-(St)+$\sum f(t)$ | Average annual cost ($T_A$) |
|---------|--------|--------|--------|--------|--------|
| 1 | 150 | 250 | 500 | 400 | 400 |
| 2 | 200 | 125 | 525 | 750 | 375 |
| 3 | 250 | 75 | 550 | 1075 | 358 |
| 4 | 300 | 50 | 600 | 1450 | 363 |
| 5 | 375 | 40 | 650 | 1885 | 377 |
| 6 | 450 | 25 | 725 | 2425 | 404 |
| 7 | 575 | 0 | 800 | 3100 | 443 |

Since the annual average value $T_A$ is minimum at the end of third year, the press should be replaced after every third year.

B)

The given problem is a balanced minimisation assignment problem.

Step I & II: The minimum time elements in row 1, 2 and 3 are 70, 50 and 110 respectively. We subtract these elements from all elements in their respective row. The reduced matrix is shown in Table 1.

Table 1

| Software Programmes | A | B | C |
|---------------------|---|---|---|
| 1 | 30 | 15 | 0 |
| 2 | 0 | 20 | 60 |
| 3 | 0 | 10 | 20 |

The minimum time elements in columns A, B and C are 0, 10 and 0 respectively. Subtract these elements from all the elements in their respective columns to get the reduced time matrix as shown in Table 2.

Table 2

| Software Programmes | A | B | C |
|---------------------|---|---|---|
| 1 | 30 | 5 | 0 |
| 2 | 0 | 10 | 60 |
| 3 | 0 | 0 | 20 |

Step 3(a): The minimum number of horizontal and vertical lines to cover all zeros is 3, which is equal to the order of the matrix. Examine all rows one by one starting from row 1 until a row containing only single zero element is located. Assign this zero. All zeros in the assigned column are crossed off as shown in Table 3.

Table 3

| Software Programmes | A | B | C |
|---|---|---|---|
| 1 | 30 | 5 | 0 |
| 2 | 0 | 10 | 60 |
| 3 | X | 0 | 20 |

Step 3(b): Now examine each column starting from A. There is only one zero in column B. Assign this as shown in Table 4.

Table 4

| Software Programmes | A | B | C |
|---|---|---|---|
| 1 | 30 | 5 | 0 |
| 2 | 0 | 10 | 60 |
| 3 | X | 0 | 20 |

Step 3(c): Since the number of assignments (=3) equals the number of rows, the optimal solution is obtained. The pattern of assignments among software professionals and programs with their respective time (in minutes) is given below:

| Program | A Software Programmes | Time (in Minutes) |
|---|---|---|
| 1 | C | 70 |
| 2 | A | 50 |
| 3 | B | 120 |
| Total | | 240 |

C i )

| Job Analysis | Value Analysis |
|---|---|
| 1)Process of determining task components or work content of a job so as to access relative worth of different jobs. | Systematic application of established techniques to identify functions of product or component and to provide those functions at lowest possible cost. |
| 2)Technique of merit rating | Technique of cost reduction |

ii)

| Stock Turnover | Labour Turnover |
|---|---|
| 1)It indicates number of times inventory of an organization is rotated during the year. | Rate of change in average labour force during the year. |
| 2)Increase in stock turnover is a healthy sign for the organization as it indicates increase in sales resulting in increased revenue for the organization. | Increase in labour turnover is not a good sign for management as it indicates dissatisfaction among employees resulting loss in productivity and increased costs. |

15 A)XYZ Ltd has 3 factories and 3 customers. The following table gives the transportation cost per unit from the factories to the customers and also the quantities available and required. Determine the initial transportation cost per unit from the factories to the customers and also quantities available and required. Determine the initial transportation solution using Vogel's method.

| Factory | P | Q | R | Availability |
|---------|---|---|---|--------------|
| F1 | 10 | 11 | 20 | 10 |
| F2 | 15 | 12 | 10 | 2 |
| F3 | 17 | 9 | 16 | 8 |
| Requirement | 8 | 5 | 7 | 20 |

B(I) What is Delphi technique? What is its applicability in a manufacturing organization?

(II)Write short note on Six Sigma quality programme.

C)

The following tasks are to be performed on an assembly line in the sequence and times specified:

| Task | Time (Seconds) | Tasks that must precede |
|------|----------------|-------------------------|
| A | 50 | - |
| B | 40 | - |
| C | 20 | A |
| D | 45 | C |
| E | 20 | C |
| F | 25 | D |
| G | 10 | E |
| H | 35 | B,F,G |

(i)     Draw the schematic diagram

(ii)    What is the theoretical minimum number of stations required to meet a forecasted demand of 400 units per an 8 hours?

(iii)   Use the longest task time rule and balance the line in the minimum number of stations to produce 400 units per day.

(iv)    Evaluate the Line Efficiency and the Smoothness Index

Ans: A) The problem is a balanced transportation problem because both demand and supply are equal to 20.

The cost matrix and the penalties are:

| Factory | P | Q | R | Availability | Row Penalty |
|---------|---|---|---|--------------|-------------|
| F1 | 10 | 11 | 20 | 10 | (11-10)=1 |
| F2 | 15 | 12 | 10 | 2 | (12-10)=2 |
| F3 | 17 | 9 (5) | 16 (3) | 8 | (16-9)=7 |
| Requirement | 8 | 5 | 7 | 20 | |
| Column penalty | (15-10)=5 | (11-9)=2 | (16-10)=6 | | |

The maximum penalty is for third row F3, lowest cost in col. Q(2,2) i.e. Rs 9. Maximum possible units is allocated to col. Q, i.e. 5 units. As Q is satisfied, column 2 is deleted.

Again, the maximum penalty is for third row i.e. F3, lowest cost in col. Q(3,3) i.e. Rs 16. Maximum possible units is allocated to col. Q, i.e. 3 units. Now, F3 is satisfied, row 3 is deleted.

The shrunken matrix is given below:

| Factory | P | R | Availability | Row Penalty |
|---------|---|---|--------------|-------------|
| F1 | 10(8) | 20(2) | 10 | (11-10)=1 |
| F2 | 15 | 10(2) | 2 | (12-10)=2 |
| Requirement | 8 | 4 | 12 | |
| Column penalty | (15-10)=5 | (16-10)=6 | | |

The maximum penalty is for col. R, lowest in row F2 i.e. Rs 10. Maximum units allocated is 2 units. As F2 is satisfied, row F2 deleted.

Now the balance will be allocated to F1 i.e. 8 units to P and 2 units to R.

Thus , the initial solution by Vogel's method is given in following table:

| Factory | P | | Q | | R | Availability |
|---------|---|---|---|---|---|--------------|
| F1 | (8) | | - | | (2) | 10 |
| F2 | | | | | (2) | 2 |
| F3 | | | (5) | | (3) | 8 |
| Requirement | 8 | | 5 | | 7 | 20 |

B (I) Delphi technique is a qualitative technique of forecasting which is an opinion pool method, in which opinions of experts are pooled before arriving at a decision. However , the pooled opinion and decision is arrived at by consensus and not by compromise of opinion of experts.

The **Delphi method** is a structured communication technique, originally developed as a systematic, interactive <u>forecasting</u> method which relies on a panel of experts. The experts answer questionnaires in two or more rounds. After each round, a facilitator provides an anonymous summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments. Thus, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. It is believed that during this process the range of the answers will decrease and the group will converge towards the "correct" answer. Finally, the process is stopped after a pre-defined stop criterion (e.g. number of rounds, achievement of consensus, stability of results) and the <u>mean</u> or <u>median</u> scores of the final rounds determine the results.

Delphi is based on the principle that forecasts (or decisions) from a structured group of individuals are more accurate than those from unstructured groups. The technique can also be adapted for use in face-to-face meetings, and is then called mini-Delphi or Estimate-Talk-Estimate (ETE). Delphi has been widely used for business forecasting and has certain advantages over another structured forecasting approach, <u>prediction markets</u>.

Delphi technique is applied in a manufacturing organization in forecasting demand of customers, manpower requirement in future etc.

(II) Six Sigma Quality program is company- wide approach for continuous improvement in quality of products and services. It measures the degree to which the process deviates from the standards and takes efforts to improve the process to achieve customer satisfaction.

The objective of Six Sigma Quality programme are two –fold:

i)to improve the customer satisfaction and reducing and eliminating gaps/defects and

ii) to continuously improve processes throughout the organization with a view to reduce sources of variation and improve quality as well as productivity.

It is a statistical measurement which tells us how good our products, services and process are and enables us to benchmark our operations with the best in the field. It thus helps us to establish our course in the race for total customer satisfaction.

A process at 6- Sigma level normally produces 3-4 non conformances in a million operations. This is supposed to be the best-in-class quality. Thus 6-Sigma is essentially a philosophy of working smarter. This means making fewer mistakes in everything we do. As we discover and eliminate the sources of variation , the non conformances are eliminated and the process capability improves.

C)

(i) Schematic Diagram:



**(Activity on Node)**
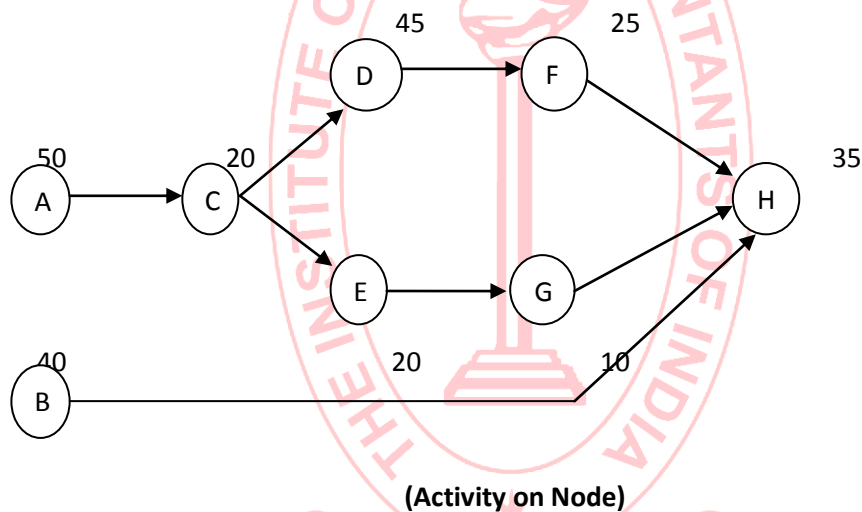
(ii) Theoretical minimum number of stations to meet D = 400 is:

$$N_t = T/C = \frac{245}{\{(60 \text{ seconds} \times 480 \text{ minutes}) \div 400 \text{ units}\}}$$

$$= 245 \div 72$$

$$= 3.4 \text{ say } 4$$

(iii) Line Balancing:

| Station | Task | Task Time (Seconds) | Unassigned Time (Seconds) | Feasible Remaining Task | Station Time (Seconds) | Cycle time (Seconds) |
|---------|------|---------------------|---------------------------|-------------------------|------------------------|----------------------|
| 1 | A | 50 | 22 | C | 70 | 70 |
|   | C | 20 | 2 | None |  |  |
| 2 | D | 45 | 27 | E,F | 70 | 70 |
|   | F | 25 | 2 | None |  |  |
| 3 | B | 40 | 32 | E |  |  |
|   | E | 20 | 12 | G | 70 | 70 |
|   | G | 10 | 2 | None |  |  |
| 4 | H | 35 | 37 | None | 35 | 70 |
| Total |  |  |  |  | 245 | 280 |

(iv) Line Efficiency = (245/280) x 100 = 87.5%

Smoothness Index = $\sqrt{(70-70)^2 + (70-70)^2 + (70-70)^2 + (70-35)^2}$

$= \sqrt{(35)^2}$ = 35%.

## Section II(Information Systems)

16 A) Choose the most appropriate answer from the four alternatives in the set: (Answer in **bold**)

i)System analyst develops the general layout of application in this stage:

a)Program coding.

**b)Program design. (Note:** The analysts put the problems' solution for application in graphical manner just like before a building construction architect designs the layout and other details.)

c)Program analysis.

d)Program documentation.

ii)Blue tooth technology

**a)Short range communication with wireless facility.(Note:** This technology enables its users to coordinate data exchange between mobile phones, computers and printers for sending , receiving and printing information without the need of connecting to each other**.)**

b)Long range communication with wire facility.

c)Only point-to point connection.

d)Requires high cost trans-receiver chip in every device.

iii) 'Firmware' is associated with:

a)Application software for firms.

b) Special purpose hardware device.

c) Benchmark software.

**d) Software in ROM.(Note:** In electronic systems and computing, **firmware** is the combination of persistent memory and program code and data stored in it. Firmware is held in non-volatile memory devices such as ROM, EPROM, or flash memory.)

iv) Which of the following is NOT an operating system?

a) OS/2

b)DOS

**c)Oracle.(Note:** The Oracle Database (commonly referred to as Oracle RDBMS or simply as Oracle) is an object-relational database management system produced and marketed by Oracle Corporation.)

d)MAC

v) The concept of 'cylinder' is used in respect of the device:

a)Tape Drive

**b) Disk Pack.[Note :** A Disk pack is a layered grouping of hard disk platters (circular, rigid discs coated with a magnetic data storage surface). A disk pack is the core component of a hard disk drive.]

c) Compact Disk

d) Daisy Wheel Printer.

vi) OCR is :

**a)Input device.(Note** : Optical character recognition, usually abbreviated to **OCR**, is the mechanical or electronic conversion of scanned images of handwritten, typewritten or printed text into machine-encoded text. It is widely used as a form of data entry from some sort of original paper data source, whether documents, sales receipts, mail, or any number of printed records.)

b)Output device

c)Processing device

d)Storage device.

vii) Point-of- Sale or POS pertains to:

a)Sales points plotted in computer graphics

b)Sales between two locations

c)A value that identifies the location of sales data in storage.

**d) An input-output device updating sales and inventory. (Note :** In recent years, a number of companies have offered Apple-centric POS systems for hospitality and retail including NCR Silver, Revel Systems, Prosperity POS, Lavu POS, ShopKeep POS, LightSpeed, and SalesVu)

viii) Key field implies:

a)Alpha-numeric field.

b)Only numeric field.

c)**Search field.(Note :** A key is a data item that allows us to uniquely identify individual occurrences or an entity type. You can sort and quickly retrieve information from a database by choosing one or more fields (ie attributes) to act as *keys*.)

d)Important field.


ix) Barcode is:

a)Unit used in banking industry

b)**Universal product code.(Note :** A barcode is an optical machine-readable representation of data relating to the object to which it is attached. Originally barcodes systematically represented data by varying the widths and spacings of parallel lines. The first use of barcodes was to label railroad cars, but they were not commercially successful until they were used to automate supermarket checkout systems, a task for which they have become almost universal.)

c)Spreadsheet package

d)Scan graphs.


x)Asymmetric  crypto system :

a)Disaster recovery system.

b)**Security system.(Note :** The IT Act u/s3 provides that the authentication of electronic record shall be effected by the use of asymmetric crypto system, which is a system of a secure key pair consisting of a private key for creating a digital signature and a public key to verify the digital signature.)

c)Control system.

d)Database .


B) Complete the following sentences by putting an appropriate word in the blank position: (Answer
 given  in **bold**).

i)------------ is a place that a user can create to store files. (**Folder . Note :** Folder is a virtual container within a digital file system, in which groups of files and other folders can be kept and organized.)

ii)A ------------- consists of a number of digits or characters or combination of both to denote a specific entity.(**code. Note :** Computer code is  the symbolic arrangement of data or instructions in a computer program or the set of such instructions.)

iii)----------------------is defined as the capacity the schema at one level of database without having to change the schema at the next higher level. (**Data independence. Note :** Data independence is the type of data transparency that matters for a centralized DBMS. It refers to the immunity of user applications to make changes in the definition and organization of data.)

iv)A ---------------------is a set standards or rules. (**protocol. Note :** A communications protocol is a system of digital message formats and rules for exchanging those messages in or between computing systems and in telecommunications.)

v) SAPAG is a popular ----------package.(**ERP. Note:** SAP AG is a German multinational software corporation that makes enterprise software to manage business operations and customer relations.)

vi) An ------------is a boundary shared by human beings and computer.(**interface. Note :** In the field of computer science, an **interface** is a tool and concept that refers to a point of interaction between components, and is applicable at the level of both hardware and software.)

vii)--------------- is pictorial representation of an algorithm. (**Flow chart.  Note:** A flowchart is a type of diagram that represents an algorithm or process, showing the steps as boxes of various kinds, and their

order by connecting them with arrows. This diagrammatic representation can give a step-by-step solution to a given problem.)

viii)Total which is used for checking and validation and donot have any significance in accounting is called -----------------.(**Hash totals or Control Totals. Note:** This is just a batch total done on one or more numeric fields which appears in every record. This is a meaningless total, *e.g.*, add the Telephone Numbers together for a number of Customers.)

ix) Information of a permanent nature is stored in a -----------file(**master. Note :** Master files contain descriptive data, such as name and address, as well as summary information, such as amount due and year-to-date sales)

x) ----------screen is an input device.(**Touch. Note :** A touchscreen is an electronic visual display that the user can control through simple or multi-touch gestures by touching the screen with one or more fingers. Some touchscreens can also detect objects such as a stylus or ordinary or specially coated gloves.)

C) Expand the following abbreviations:
i)  ISDN- Integrated Services Digital Network.
ii) ULSI- **U**ltra **L**arge **S**cale Integration.
*iii) HVAC system- Heat Ventilation and Air Conditioning system.*
*iv)  IDS-Intrusion Detection System.*
*v)  VPN- Virtual Private Network.*
*vi)  NIC- Network Interface Card.*
*vii)  USART- Universal Synchronous /Asynchronous Receiver Transmitter*
viii) FDDI – Fiber Distributed Data Interface.
*ix)* APRANET-Advanced Research Project Agency Network.
x)  WAIS-Wide Area Information Service

*D)* Match Column I with relevant terms in Column II:

| Column I | Column II |
|---|---|
| i) Seek time | a)Separation of blocks on magnetic tape. |
| ii)IBG | b)Picture elements of individual dots. |
| iii)Client | c) High speed buffer memory. |
| iv)Pixels | d)For read /write head to move to the desired track in disk system. |
| v) URL | e)User node |
| vi) Cache | f) Collection of computers with same access right   as every other computer on the network. |
| vii)Public key and Private Key | g)Protection against intrusion. |
| viii) Peer- to-peer | h) Provides information about location of a document. |
| ix)CASE | i)Digital Signature |
| x)Firewall | j)A tool for software development |

Ans:

i-d

ii-a

iii-e

iv-b

v-h

vi-c

vii-i

viii-f

ix-j

x-g

17 A) Which are the five pillars upon which a computer based information system rests?

B) Explain the concept of decomposition of system with the help of an example.

C) What is Information? How does it differ from Information System.

Ans: A) The computer based information system rests upon the following pillars:

i)Persons: Collection to end use of results through processing persons are involved.

ii)Procedures: Guidelines to be followed while using data, hardware and software.

iii)Hardware: Computer equipment.

iv)Software: Programs or step by instructions to the computer on how to do its work.

v)Data : Unprocessed facts, relating to transactions and entities in a system, that must be manipulated (classified, sorted, computed, and summarized).

B) A computer system is difficult to comprehend when considered as a whole. Therefore, it is better that the system is decomposed or factored into sub systems. **Decomposition** in computer science, also known as *factoring*, refers to the process by which a complex problem or system is broken down into parts that are easier to conceive, understand, program, and maintain. The boundaries and interfaces are defined, so that sum of the sub systems constitutes the entire system. This process of decomposition is continued with sub systems divided into smaller sub
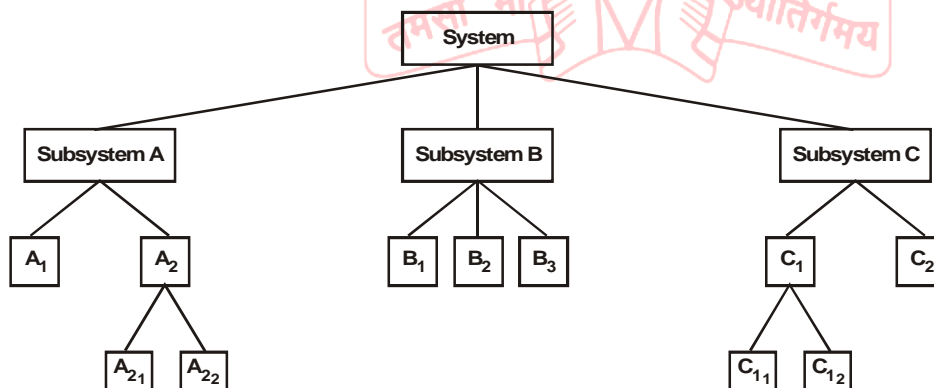


systems until the smallest sub systems are of manageable size. The sub systems resulting from this process generally form hierarchical structure as shown in the figure given below:

**Hierarchical relations of subsystems**

An example of decomposition is the factoring of an information processing system into sub systems. One approach to decomposition might proceed as follows:

I.   Information system divided into sub system such as:

Sales and order entry

Inventory

Production

Personnel and payroll

Purchasing

Accounting and control

II.  Each sub system is divided further into sub systems. For example, the personnel and payroll sub system might be divided into the following smaller sub systems:

Creation and update of personnel pay roll records.

Personnel reports

Payroll data entry and validation

Salaried payroll processing

Payroll reports for management

Payroll reports for Government

III. If the task is to design and program a new system, the sub systems (major applications) defined above might be further sub divided into smaller sub systems or modules.

Decomposition into sub systems is used to analyse an existing system and to design and implement a new system.  In both the cases, the designer must decide how to factor i.e. where to draw the boundaries.

The general principle in decomposition, which assumes that system objectives dictate the process, is functional cohesion. Components are considered to be part of the same sub system if they perform or are related to the same function.  The boundary then needs to be clearly specified, interfaces simplified and appropriate connections established among the subsystems.

C) Information is data that has been processed into meaningful form so that it can be effectively interpreted and help the user in decision making. Information consists of data, text, images, voice etc. On other hand, Information System is the vehicle that supplies necessary information for decision making. The information system is to feed the management for control purpose. The activities in an information system are:

i)collection ,storing, and processing of data

ii)generation of information reports

iii)dissemination of information to right users

18 A) What do you understand by program documentation?

B) You have been appointed as  the Project Manager of a ADC Software Ltd . with the responsibility for developing a break-through product, combining state of the art hardware and software, will you opt for prototyping as a process model for a product meant for the intensely competitive entertainment market?

Ans: A). The writing of narrative procedures and instructions for people who will use software is done throughout the program life cycle. User documentation should also be reviewed for understandability.  Program design and a set of technical design specifications must include the following:

I.   A brief narrative description of what the program should do.

II.  A description of the outputs, inputs and processing to be performed by the program.

III. A deadline for finishing the program.

IV.  The identity of the programming language to use and the coding standards to follow.

V.   A description of the system environment into which the program should fit.

VI.  A description of the testing required to certify the program for use.

VII. A description of documentation that must be generated for users, maintenance programmers and operational personnel.


B) Prototyping technique is used to develop smaller systems such as decision support systems, management information systems and expert systems. The goal of prototyping approach is to develop a small or pilot version called a prototype of part or all of a system. A prototype is a usable system or system component that is built quickly and at a lesser cost, and with the intention of being modifying or replacing it by a full scale and fully operational system. Finally, when a prototype is developed that satisfies all user requirements, either it is refined and turned into the final system or it is scrapped. If it is scrapped, the knowledge gained from building the prototype is develop the real system

Prototyping as a process model will be inappropriate and hence inadvisable for the following reasons:

(i)   Prototyping requires user involvement.  Here the users are the consumers of the product  who are diffused and may not be inclined to join in.

(ii)  When we try to test the product with the involvement of customers, confidential or critical information might get leaked  to the competitors on our line of thinking. The element of surprise and also  the opportunity to capture the market will be lost.

(iii)Prototyping requires significant time for experimenting. Since the product is meant for the intensely  competitive entertainment market, the project manager may not have that much time to experiment, the competitor may capture the market by entering the market in advance.


19 A)  Differentiate between:

i) Microprocessor and Microcomputer.

ii)File Retention and File Recovery.

B) What is a virus scanner ? Briefly describe the functions of a virus scanner.

Ans: A)

i)

| Microprocessor | Microcomputer. |
|---|---|
| a)It is a device having tremendous processing capacity of doing logical and arithmetic processing. | It is collection of various Input/Output devices, processor, etc. so as to form a complete computer., |
| b)All major calculations and comparisons as well as activating and controlling the operation of other units are performed by the microprocessor. | It can do all the activities of a micro processor plus more. |
| c)Microprocessor is a part of micro computer. | A microcomputer is a complete system in itself. When a microprocessor is combined with Input/Output and storage devices, it is called microcomputer . |
| d) Primary storage not available. | It has a primary storage unit. |
| e) It cannot work 100% independently. | Can work 100% independently. |
| f) E.g. Intel IC( Integrated Chip) | E.g Apple, Machintosh, etc. |

ii)

| File Retention | File Recovery |
|---|---|
| a)File retention is the process of permanent storage of data. | File recovery is the process of retrieval of data, which has been fully/partly corrupted due to logical or physical errors on the storage media. |
| b)File retention can be done into two categories of devices viz. Random and Sequential access. Random devices allow access to information directly and not in order in which they are sorted, whereas in Sequential devices, storage and retrieval has to be done in the same order. | File recovery is generally done using certain third party utilities. |

B) A Computer virus is a set of instructions purposely entered into the system to cause harm to the data stored in it or only to scare the user by appearing. In many cases, viruses can be highly destructive for organisation's DP System. A Computer virus often spreads itself by first infecting executable files or system areas of hard or floppy disks and then making copies of itself.

A Virus Scanner is a device /program, which takes care of locating the viruses and protecting the system by either removing the viruses or by not allowing them to do any harmful act. It is thus one kind of an anti-virus program that can spot a virus before the virus can cause any harm.

Virus Scanners are designed to help identify viruses within files, boot sectors, master boot sectors, memory and other hiding places and help to remove them. The capability to detect and identify a virus is probably the most important feature of a Virus Scanner .

Virus Scanners can be obtained from the market or can be downloaded from the Internet and installed in the system. Examples- Norton Antivirus, Gri-soft AVG Antivirus, Spy ware Doctor, just to name a few.

20 A) What are the main pre-requisites of a Management Information System, which make it an effective tool ?

B)What is the purpose of testing ? What are the steps involved in designing of tests for elimination of errors?

Ans: A) The following are pre-requisites of an effective MIS:

**(i) Database –** It is a superfile which consolidates data records formerly stored in many data files. The data in database is organised in such a way that access to the data is improved and redundancy is reduced. Normally, the database is subdivided into major information sub-sets needed to run. The database should be user-oriented, capable of being used as a common data source, available to authorized persons only and should be controlled by a separate authority such as DBMS. Such a database is capable of meeting information requirements of its executives, which is necessary for planning, organising and controlling the operations of the business.

**(ii) Qualified System and Management Staff -** MIS should be manned by qualified officers. These officers who are experts in the field should understand clearly the views of their fellow officers. The organizational management base should comprise of two categories of officers (i) System and Computer experts and (ii) Management experts. Management experts should clearly understand the concepts and operations of a computer. Their whole hearted support and cooperation will help in making MIS an effective one.

**(iii) Support of Top Management -** An MIS becomes effective only if it receives the full support of top management. To gain the support of top management, the officer should place before them all the supporting facts and state clearly the benefits which will accrue from it to the concern. This step will certainly enlighten the management and will change their attitude towards MIS.

**(iv) Control and Maintenance of MIS –** Control of the MIS means the operation of the system as it was designed to operate. Sometimes users develop their own procedures or shortcut methods to use the system, which reduces its effectiveness. To check such habits of users, the management at each level in the organisation should device checks for the information system control.

Maintenance is closely related to control. There are times when the need for improvements to the system will be discovered. Formal methods for changing and documenting changes must be provided.

**(v) Evaluation of MIS –** An effective MIS should be capable of meeting the information requirements of its executives in future as well. The capability can be maintained by evaluating the MIS and taking appropriate timely action. The evaluation of MIS should take into account the following points:

➢ Examining the flexibility to cope with future requirements ;

➢ Ascertaining the view of the users and designers about the capabilities and deficiencies of the system ;

➢ Guiding the appropriate authority about the steps to be taken to maintain effectiveness of MIS.

B)The purpose of testing is to determine whether the developed or acquired software achieves its specified requirements. During this process, program design errors or program coding errors may arise. Even insufficiency or inaccurate specifications may be detected. Testing can however detect only presence of errors and not absence of errors.

Designing of tests is very important for elimination of errors.

Key steps involved in designing of tests for elimination of errors:
- ✓ Selection of boundaries of the test.
- ✓ Determination of the goals of the test.
- ✓ Selection of testing approach-black box or white box.
- ✓ Development of test data to accomplish the goal of test.
- ✓ Conducting the test through execution of test data or simulation of program execution plan.
- ✓ Evaluation of the test result against expected results and determination of the nature of discrepancies.
- ✓ Determination of the testing process.


21 A)What do you understand by personnel information system? Write in brief about its subsystems that increase its operational efficiency.

B) "Executives require information to perform the function of planning". In this context list out the requirements in planning a marketing system.


Ans: A) The personnel information system deals with the flow of information about people working in the organisation as well as future personnel needs. In most of the organisations, the system is concerned primarily with the six basic sub-systems of the personnel function; recruitment, placement, training, compensation, maintenance and health and safety..

It is generally accepted that the personnel function is one of the least computerised of all the functions. Automated system may not be necessary for small, but large business firms are realising that computer based personnel information systems are necessary for increasing the operational efficiency of personnel management. Originally, many organisations used computer−based information systems to produce pay cheques and payroll reports, maintain personnel records and analyse the use of personnel in business operations. Many organisations have gone beyond these traditional functions and have developed personnel information systems, which also support (i) recruitment, selection and hiring (ii) job placement (iii) performance appraisals, (iv) employee benefit analysis, (v) training and development and (vi) health, safety and security. Such information system support the concept of human resource management (HRM). The goal of HRM is the effective and efficient use of the human resources of a company.

The personnel system should be organised on functional basis. It should have the following information sub−systems to increase the operational efficiency of personnel management.

I. **Recruitment:** Properly managed recruitment sub−system may forecast personnel needs and skills required for recruiting personnel at the proper time to meet organisational manpower needs. Such a sub-system may not only furnish information concerning skills required for company programmes and processes but also maintains the inventory of skills available within the organisation.

II. **Placement:** This sub-system is concerned with the task of matching the available persons with the requirements. A good placement sub-system makes use of latest behavioral tools and techniques. It ensures that the capabilities of people are identified before being matched with properly organised work requirements.

III. **Training and development**: As technological changes and demands for new skills accelerate, many companies find that they must develop much of their requirements from internal sources. In addition, a large part of the workforce must constantly be updated in new techniques and developments. This task is the function of the training and development sub−system.

IV. **Compensation**: This sub-system is concerned with the task of determining pay and other benefits for the workers of the concern. It makes use of traditional payroll and other financial records, government reports and unions expectation before arriving at the final figures of pay and other benefits for each category of workers.

V. **Maintenance:** This sub-system is designed to ensure that personnel policies and procedures are achieved. It may be extended to the operation of systems of control, work standards which are required to measure performance against financial plans or other programmes, and the many subsidiary records normally associated with the collection, maintenance and dissemination of personnel data.

VI. **Health & Safety**: This sub-system is concerned with the health of personnel and the safety of jobs in the organisation.

B) The information required for the purpose of planning in the case of a marketing system can be classified into three types:

(i) **Environmental Information:** It includes the following:

    (a) **Political and Governmental considerations:** To forecast market plan, political stability etc., information plays an important role as it enables executives to guess quite accurately the financial policies, taxation and their effect on the organization.

    (b) **Demographic and social trends:** Information about demography, its compositions and location is also useful to business organisation for planning its products, services or outputs.

    (c) **Economic trends:** This includes information related to the GNP level and trend, disposable income of consumers, employment, productivity, capital investments, prices, wage level and numerous other economic indicators which provide valuable planning information for those firms whose output is function of these variables.

(ii) **Competitive information:** Data related to business operations of competing firms is quite useful for forecasting individual firm's product demand, making decisions and plans to achieve the forecast.

(iii) **Internal information:** Information available from internal sources affects the planning decisions at different levels in the organizations. The main sources of internal information are:

(a) Sale forecast,

(b) Financial plans ,

(c) Supply factors and

(d) Policies .

22 A) What are the principles that guide the design of measures and indicators to be included in Executive Information System (EIS)?

B) Briefly discuss four basic components of Decision Support System.

Ans: A) Various principles to be followed while designing Executive Information System (EIS) are:

(i) EIS measures must be easy to understand and collect. An EIS should not add substantially to the workload of managers or staff.

(ii) EIS measures must be based on a balanced view of the organisation's objectives.

(iii) Performance indicators in an EIS must reflect everyone's contribution in a fair and consistent way. Indicators should be as independent as possible from variables outside the control of managers.

(iv) EIS measures must encourage management and staff to share ownership of the organisation's objectives. Performance indicators must promote both team-work and friendly competition. Measures will be meaningful for all staff; people must feel that they as individuals, can contribute to improving the performance of the organization.

(v) EIS information must be available to everyone in the organization. The objective is to provide everyone with useful information about the organisation's performance. Confidential information should not be part of the EIS.

(vi) EIS measures must evolve to meet the changing needs of the organization.


B) A decision support system has the following components:

(i) **The User:** The user of a decision support system is usually a manager with an unstructured or semi-structured problem to solve. Users do not need a computer background to use a decision support system for problem solving. The most important knowledge is a thorough understanding of the problem and the factors to be considered in finding a solution. A user does not need extensive education in computer programming in part because a special planning language performs the communication function within the decision support system.

(ii) **One or more databases:** Decision support systems include one or more databases which contain both routine and non-routine data from both internal and external sources. The data from external sources include data about the operating environment surrounding an organization. Decision support system users may construct additional database themselves. Some of the data may come from internal source.

(iii) **A planning language:** Two types of planning languages that are commonly used in decision support system are (1) general purpose planning languages and (2) special purpose planning languages. General purpose planning languages allow users to perform many routine tasks like-retrieving various data from a database or performing statistical analysis. The languages in most electronic spreadsheets are good example of general purpose planning languages. These languages enable the user to tackle a broad range of budgeting, forecasting and other worksheet oriented problems. Special purpose planning languages are more limited. Some statistical languages, such as SAS, SPSS and Minitab are examples of special purpose planning languages.

(iv) **Model Base:** The model base is the "brain" of the decision support system because it performs data manipulation and computations with the data provided to it by the user and the database. There are many types of model bases but most of them are custom-developed models that do some type of mathematical functions. The analysis provided by the routine in the model base is the key to supporting the user's decision.


23 A) Before purchasing the packaged software, on what features the software will be assessed?

B) Define and differentiate between 'Scheduled maintenance' and 'Rescue maintenance' of a system.

Ans: A) Before purchasing the packaged software, the following features of the software should be assessed:

   (a) It is package really available, or is it just another example of vaporware product announced well in advance of the time when it will be actually ready use ?

   (b) Is the output produced by the package suitable in form and content to the user ?

   (c) Can the package accept the input data that the user needs to process in the form that he needs to use ?

(d) Does the package support an acceptable range of I/O devices ?

(e) Are the files created ad / or processed by the software acceptable in terms of such contents, storage media, record format, access restrictions, ad degree permanency?

(f) Does the package have an adequate response time, or the user must wait for lengthy periods while the program processes the last data entry ?

(g) Is the package "user friendly" – is it easy to learn and use ?

(h) What is the quality of the documentation ?  Are the manuals and other documents in the package complete, clearly written and well organized ?

(i) Does the package have good error – handling controls ?  Are system error reported to the users in clear messages or cryptic codes ?

(j) What is the warranty period for the package ?  What is the level of support one expect to receive from the vendor ?

(k) Does the package represent a good value for money ?  Can an attractive, acceptable, package be obtained for a significantly lower outlay ?

B) Most information systems need some modifications after development. This need arises from time to time, due to failures to anticipate all requirements during system design and/or due to changed organisational needs. The changing needs impact most information systems and thus regular systems maintenance involves adding new data elements, modifying reports, adding new reports, changing calculations etc.

Such maintenance can be categorised in the following two ways:

(I) **Scheduled Maintenance** is undertaken for tasks which can be anticipated and can be planned for in advance. An information system may remain in an operational and maintenance mode for several years. The system should be evaluated periodically to ensure that it is operating properly and is still workable for the organisation.

(II) **Rescue maintenance** refers to previously undetected malfunctions or such sudden changes that were not anticipated but require immediate solution. A system that is properly developed and tested should have few occasions of rescue maintenance. Rescue maintenance is unplanned and generally puts system stand still.

24 A) What is a database? What are the functions of DBMS?

B)Distinguish between fixed length field and variable length field (with reference to database).

Ans: A) Database refers to a logically coherent collection of data for a specific purpose e.g. predefined applications and access by identified user groups. A database  is used by an organization ti store its data from different operational areas so that they can be shared by each operation collectively. A database has similarity of the real world called mini-world or Universe of Discourse(UoD) reflecting changes in the mini world.

Database Management System (DBMS) is a collection of programmes utilized for creating and maintaining a database for benefit of the users. DBMS is thus a general –purpose software system that enables defining, constructing  and manipulating databases for various applications by properly authorized multiple users  without compromising the security and integrity of data.

DBMS offers the following services:

i)**Defining a database** means specifying data types, structures, and constraints for data which will be stored in the database.

ii**) Constructing the database** refers ti the process of storing the data in the storage medium which will be controlled by the DBMS.

iii**) Manipulating a database** refers to the functions involved in updating the database, generating reports from the data in the database, querying the database to retrieve specific data.

B)

| Fixed Length Field | Variable Length Field |
|---|---|
| Under **Fixed Length Fields** scheme, fields are simply placed in sequence one after another. Thus, while designing physical records, it conserves storage space. In this scheme, a trailing blank pad character field and leading zero pad numeric field is used. Hence, under fixed length field scheme we know the exact location within a file for each of the fields of a physical record. | **Variable Length Fields** scheme makes the location of a particular field and a particular record irregular. That is, depending on which records exist and the precise values for fields, different records and fields will be in different locations. A common way to handle variable length field is to break the relation into a fixed length physical records containing all fixed length fields and one or more variable length physical records. In personal computers, this is how many DBMS handle a memo field which is a variable-length field. |

25 A) Give one or two reasons for each of the following:
i) Need of modem in data communication
ii) Use of Router
iii) Use of Gateway in computer network
iv) Protocol Translator

B) What is a Computer network? Describe the various networking architectures.
C) Describe the benefits of SAN.

Ans: A)
i) **Need of Modem in data communication:** Modem stands for modulator/demodulator. It is a device that converts a digital computer signal into analog telephone signal or vice versa. Modems are required to tele-communicate computer data with ordinary telephone lines because computer data is in digital form but telephone lines are analog.
ii) **Use of Router:** Router is a special purpose computer or software package that handles the connection between two or more networks. Routers spend all their time looking at the destination addresses of the packets passing through them and deciding on which route the packets should be sent.
iii) **Use of Gateway in computer network:** Gateways are usually used to link LANs of different topologies, e.g., Ethernet and Token ring for enabling the exchange of data. They do not possess the management facilities of routers but like routers they can translate data from one protocol to another.

iv) **Protocol translator:** It is a peripheral device which converts the communication protocol of one system into the protocol of another system so that the two systems are compatible enabling data to be transferred between them.

B) A computer network is a collection of computers and terminal devices connected together by a communication system. The set of computers may include large- scale computers, medium -scale computers, mini -computers and micro processors. The set of terminal devices may include intelligent terminals, dumb terminals, work stations and communication hardware.

**Networking Architecture:** The way in which individual computers, called nodes on a network interact with other computers on the network depends on how they are organized. The scheme of organizing network is called networking architecture. There are two basic types of architecture:

**(i) Client – Server:** This type of network has certain machines and devices, called servers, that are specially dedicated to provide various services to other computers (called clients). The most common type of client-server arrangement is LAN composed of microcomputers connected to a network server, which serves to all the clients. A client program running on one of the microcomputers can request specific data from the server. The server program retrieves the requested data from its databases and returns it to the client. LAN permits all clients to share hardware, software and data including storage devices and printer.

**(ii) Peer-to-Peer:** In peer -to -peer architecture, there are no dedicated servers. All computers are equal, and are termed as peer. Normally each of these machines functions both as a client and server. This arrangement is suitable for environment with a limited number of users. Moreover, the users are located in the same area and security is not a critical issue while the network is envisaged to have a limited growth.

- Architecture is simple in design and maintenance.
- Network is not totally reliant on a particular computer.
- Linking of computer in peer- to -peer is simple and straight -forward.

C) A Storage Area Network (SAN) is a dedicated, centrally managed, secure information infrastructure, which enables any-to-any interconnection of servers and storage systems. Following are the benefits of SAN:

(i) **Removes data traffic:** Like back up processes, from the production network giving IT managers a strategic way to improve system performance and application availability.

(ii) **Improves data access:** Using fiber Channel connections, SAN provides high speed network communication and distance needed by remote workstations and servers to easily access shared data storage pools.

(iii) **Centralized Management of Data:** IT managers can more easily centralize the management of their storage systems and consolidate backups, increasing overall system efficiency. The increased distances provided by Fiber Channel Technology makes it easier to deploy remote disaster recovery sites. Fiber Channel and switched fabric technology eliminate single point of failure on the network.

(iv) **Unlimited network expansion:** Unlimited expansion is possible with hubs and switches. Nodes can be removed or added with minimal disruption to the network

26 A) Mention  the basic  features offered by e-mail   package.

B) What are the constituents of a Data Centre ?

C) Explain, the concept of voice messaging.

Ans: A) Electronic mail (email) on the Internet provides quick, cost effective transfer of messages to other e-mail users worldwide. The email software comprises of many important and useful features. Some of them are as follows:

(i) **Composing messages:** With the help of Internet Browser, it is possible to compose messages in an attractive way with the help of various fonts. It is also possible to spell-check the message before finalizing it.

(ii) **Replying to mails received:** It is possible to reply to any mail received by merely using the ' Reply' facility available on the Internet Browser. This facility also allows one to send the same reply to all the recipients of the original message. This helps in saving lot of time in terms of remembering addresses and also in  typing the subject matter.

(iii) **Address book:** This is an electronic form of address book wherein the following features can be saved: Name, full address, email address, organization and designation of person etc.

When one has to send the email, by merely typing the first name, it would be possible to recall the email address of the recipient. It is also possible to store addresses on the basis of categories.

(iv) **Printing of messages:** It is possible to print messages received as well as messages sent. As a result, hard copy  of any message can also be kept.

(v) **Offline Editing / Composing/ Reading:** One does not have to be connected to the Internet all the time to be able to read/ edit/ compose messages. Ideally, one should log on to the Internet, download all the messages on to one's own hard disk and then get disconnected from the Internet. Once user is offline, he should read all the messages that have been received. Even composing messages can be done offline. This saves Internet time as well as helps in keeping the telephone line free.

(vi) **Forwarding of messages:** It is possible to forward any messages received from one user  to another user without retyping the message.

(vii) **Transfer of data files:** Data files can also be sent / received to / from the client. This helps in saving of considerable amount of time, energy and money.

(viii)**Greeting Cards:** On the Internet, there are several sites which  offer free greeting cards for thousands of occasions. One has to visit that site, select the card and by typing the email address, card can be sent to different users.

B) To keep equipments running reliably, even under the worst circumstances, the data centre is built with following carefully engineered support infrastructure:

(i) Network connectivity with various levels of physical connectivity using Fibre Optic and copper communication link and service provider redundancy.

(ii) Dual DG sets and Dual UPS,

(iii) Heating, ventilation and Air Conditioning (HVAC) systems for temperature control.

(iv) Fire extinguishers.

(v) Physical security systems like Security guards, Biometric devices, Smart Card, CCTV etc.

(vi) Raised flooring to avoid flood and water logging.

(vii) Network equipments, Network Management software,

(viii) Network security by segregating the public and private network using Intrusion detection system (IDS) and firewalls.

C) Voice messaging is a communication approach, which is similar to the electronic mail except that it is audio message rather than text messages that are processed. A sender speaks into a telephone rather than typing, giving the name of recipient and the message and the sender's voice signal is then digitized and stored. The system can then either deliver the message at a specified time in the future or it can be retrieved from a database by the recipient. The message is reconverted into its analog format when it is delivered or retrieved so that the recipient hears it as the original sender's voice on a telephone.

Voice messaging requires a computer with an ability to store the audio messages in digital form and then convert them back in audio form upon retrieval. Each user has a voice mail box in secondary storage, and special equipment converts the audio message to and from the digital form. The main advantage of voice messaging over electronic mail is that the sender does not have to type the message.

More advanced systems may be integrated with a company's PABX, with a call center ACD for automatic call distribution; with mobile or paging terminals for message alert; and computer systems/data bases for delivering information or processing orders. Interactive Voice Response (IVR) systems may use digital information stored in a corporate data base to select pre-recorded words and phrases stored in a voicemail vocabulary to form sentences that are delivered to the caller.

Voice-mail systems contain several elements shown in the figure below:

- A central processor (CPU) which runs the operating system and a program (software) that gives the system the look-and-feel of a voice-mail system. This software includes thousands of pre-recorded prompts that "speak" to the users as they interact with the system;
- Disk controller and multiple disk drives for message storage;
- System disks which not only include the software above, but also contain a complete directory of all users with pertinent data about each (name, extension number, voice-mail preferences, and pointers to each of the messages stored on the message disk that belong to them);
- Telephone interface system that enables many phone lines to be connected to it.

Voice mail's introduction enabled people to leave lengthy, secure and detailed messages in natural voice, working hand-in-hand with corporate phone systems. The adoption of voice-mail in corporations improved the flow of communications and saved huge amounts of money. Needless to say, the ability to tell someone something without talking to them, can be a powerful reason to choose Voice-mail for delivery of a particular message.

27 A) Write down the general guidelines which are to be followed before starting the implementation of an ERP package.

B) What do you understand by enterprise controlling?

Ans: A) There are certain general guidelines, which are to be followed before starting the implementation of an ERP package:

(i) Understanding the corporate needs and culture of the organisation and then adopt the implementation technique to match these factors.

(ii) Doing a business process redesign exercise prior to starting the implementation.

(iii) Establishing a good communication network across the organisation.

(iv) Providing a strong and effective leadership so that people down the line are well motivated.

(v) Finding an efficient and capable project manager.

(vi) Creating a balanced team of implementation consultants who can work together as a team.

(vii) Selecting a good implementation methodology with minimum customisation.

(viii) Training end-users.

(ix) Adapting the new system and making the required changes in the working environment to make effective use of the system in future.


B) Enterprise can be managed by using an integrated enterprise management. This consists of getting accounting data prepared by subsidiaries for corporate reporting which will be automatically prepared simultaneously within the local books of each subsidiary. This data is transferred to a module called enterprise controlling (EC).

It is easy to transfer the data to the EC module to automatically set up consolidated financial statements including elimination of inter-company transactions currency translations etc. Enterprise controlling consist of 3 modules. EC-CS component is used for financial statutory and management consolidation. EC-PCA allows to work with internal transfer prices and at the same time to have the right values from company, profit centre and enterprise perspectives in parallel. It is also possible to take data directly from EC-PCA to ES-CS consolidation.

EC-EIS (Executive Information System) allows to take financial data from EC-PCA, EC-CS or any other application and combines with any external data such as market data, industry benchmark and / or data from non-SAP applications to build a company specific comprehensive enterprise information system.

EC allows to control the whole enterprise from a corporate and a business unit perspective within one common infrastructure. From EC-EIS top-level2 reports, end users can drill down to more detailed information within EC or any other R/3 application.


28 A) What is an automated office? List the automated office components along with their major functions.

B) State and explain the four back up and recovery features necessary in a DBMS.

C) Discuss the common types of field interrogation as a validation control procedure in an EDP set up.

Ans: A) Automated office is a multifunction integrated computer based system that allows many office activities to be performed in an electronic mode. It is a new way of preparing documents and enhanced communication method. It places the power of computing in hands of office executives. It helps in filing, storing and retrieving documents.

 Components of the automated office and major functions thereof are:

 (i)Word processing- It provides preparation of typed document in different ways , their storage , revision and printing.

 (ii) Electronic Mail- It allows typed message to be sent to or received from any part of the world electronically.

 (iii) Voice Mail- It facilitates spoken message to be sent to or received from any part of the world electronically.

 (iv) Facsimile- It allows any typed or handwritten or printed documents to be sent to or received from any part of the world electronically.

(v) Tele-conferencing- It facilitates conferencing or meeting among persons located at different places.

(vi) Personal computing- It places computing decision support at workers' fingertips.

(vii) Reprographics – A combination of automated machines for providing multiplicities of documents like photocopies, scanners, laser printers etc.

B) The four backup and recovery features necessary in a DBMS are discussed below:

(i) **Database backup:** The backup features makes a periodic backup of the entire database. This is an automatic procedure that should be performed at least once a day. The backup copy should be stored in a secure remote area.

(ii) **Transaction log:** This feature provides an audit trail of all processed transactions. It lists transactions in a transactions log file and records the resulting changes to the database in a separate database change log.

(iii) **Checkpoint feature:** The checkpoint facility suspends all data processing while the system reconciles the transaction log and the database change log against the database. At this point the system is in a "quiet state". Checkpoints occur automatically several times an hour. If a failure occurs, it is usually possible to restart the processing from the last check point. Thus, only a few minutes of transaction processing must be repeated.

(iv) **Recovery Module:** The recovery module uses the logs and backup files to restart the system after a failure.

C) The common types of field interrogation as a validation control procedure in an EDP set up are discussed below:

(i) *Limit Checks*: The field is checked by the program to ensure that its value lies within certain predefined limits.

(ii) *Picture checks*: These check against entry of incorrect characters into processing.

(iii) *Valid Code Checks*: Checks are made against predetermined transactions codes, tables or other data to ensure that input data are valid. They may either be embedded in the programs or stored in files.

(iv) *Check digit*: It is an extra digit that is added to the code when it is originally assigned. It allows the integrity of the code to be established during subsequent processing.

(v) *Arithmetic Checks*: Arithmetic is performed in different ways to validate the result of other computations of the values of selected data fields.

(vi) *Cross Checks*: It may be employed to verify fields appearing in different files to check that the results tally.

29 A) Why is Computer fraud a serious threat to any business organisation?

B)What points should be kept in mind while performing IS audit?

C) List the contents of Information Security policy.

Ans: A) In the modern business scenario, most of the businesses are dependent on networked or stand-alone computers. Even so, the individual businesses are also linked through computer networks or by electronic payments over the Internet. Hence, with the growth of electronic

commerce and electronic cash, there are major threats of hacking, risk of interception and thefts, as well as destruction of electronic payments during transmissions.

It is very evident that the computer fraud is very different from the conventional frauds as:

➢ It is easily hidden and hard to detect. There may not be any easily recognizable audit trail and the fraud is likely to be hidden in enormous volumes of data.

➢ Evidence of computer crime, besides being hard to be found out, is difficult to present to a court in a manner, which is legally admissible and effective. It is not only extremely difficult to prosecute or defend the computer crimes; it is very hard to ensure that the evidence complies with the relevant statutes. It is also difficult to explain to the judge or jury having insufficient exposure to computers especially in India.

➢ There are various ways, which may not be obvious, to commit the computer frauds e.g.:
  o A few keystrokes are needed to manipulate the invisible data.
  o Employees as well as outsiders can access any computer remotely.
  o Huge volume of data can be transported on a floppy or CD which can be written in a very short time.

Lack of knowledge about the functioning of computers and protection of systems enables the fraudster to take advantage and commit the computer frauds/crimes. The extent of damage caused by the unauthorized interference with computer system may be totally disproportionate with the effort involved to cause the damage e.g. the insertion of virus takes few seconds whereas the loss/damage of data may be enormous as it may have been collected and created in the organisation since the inception of the computer.

B) While performing an IS audit, auditors should ascertain that the following objectives are met:

**(i)** Security provisions protect computer equipments, programs, communications and data from unauthorized access, modifications or destruction.

**(ii)** Program development and acquisition is performed in accordance with management's general and specific authorization.

**(iii)** Program modifications have the authorization and approval of the management.

**(iv)** Processing of transactions, files, reports and other computer records is accurate and complete.

**(v)** Source data that is inaccurate or improperly authorized is identified and handled according to prescribed managerial policies.

**(vi)** Computer data files are accurate, complete, and confidential.

C) The Information Security policy should describe:

❖ The importance of Information security to the organization;

❖ A statement from the chief executive officer in support of the goals and principles of effective information security;

❖ Specific statements indicating minimum standards and compliance requirements for specific areas;

❖ Assets classification;

❖ Data Security;

❖ Personnel security;

❖ Physical, logical and environmental security;

❖ Communications security;

❖ Legal, regulatory and contractual requirements;
❖ System development and maintenance life cycle requirements;
❖ Business continuity planning;
❖ Security awareness, training and education;
❖ Security breach detection and reporting requirements; and violation enforcement provisions;
❖ Definitions of responsibilities and accountabilities for information security with appropriate separation of duties;
❖ Particular information system or issue specific areas; and Reporting responsibilities and procedures.

30 A) Explain the terms Attribution, Acknowledgement and Dispatch    of Electronic Records with reference to The Information Technology  Act, 2000.

B) Define the following terms with reference to Section 2 of Information Technology Act, 2000:

 (i)   Key Pair

(ii) Secure System

C) What do you understand by  Disc Imaging and Analysis Technique.

Ans: A) Chapter IV of the Information Technology Act 2000 explicates the manner in which electronic records are to be attributed, acknowledged and  dispatched. These provisions play a vital role while entering into agreements electronically.

Section 11 states that an electronic record shall be **attributed** to the originator as if it was sent by him or by a person authorized on his behalf or by an information system  programmed to operate on behalf of the originator.

As per Section 12, the addressee may **acknowledge** the receipt of the electronic record either in a particular manner or form as desired by the originator and in absence of such requirement, by communication of the acknowledgement to the addresses or by any conduct that would sufficiently constitute acknowledgement.

Section 13 specifies that an electronic record is said to have been **dispatched** the moment it leaves the computer resource of the originator and said to be received the moment it enters the computer resource of the addressee.

B)

i) **Key pair:** In an asymmetric crypto system, comprising of a private key and its related public key. These keys are so related that the public key can be used to verify a digital signature created by the private key.

ii) **Secure system:** It means computer hardware, software and procedures which are reasonably secure from the unauthorized access and misuse, provide a reasonable level of reliability and correct operation and adhere to generally accepted security procedures.

C) **Disc Imaging and Analysis Technique** –  enables the fraud investigator to discover evidence of transactions that the fraudster thought were inaccessible or had been destroyed.  It works in the following stages:

(i) Using specialist hardware/software without the suspect necessarily being alerted. An exact copy of the computer hard disc is taken leaving the original completely intact and leaving no trace of the copying process. This preserves the integrity of the hard disc and confidentiality of the investigation. The image is written directly to an optical disc, which can be copied onto a CD ROM for investigative purpose.

(ii) The image copy of disc is processed and areas of storage containing partially overwritten files and files which have been marked as deleted but not overwritten are recorded. At the time the image is taken, it is probable that there will be a number of deleted files or file fragments that have not been overwritten and are therefore available to investigator.

(iii) The final stage is the analysis of the processed image. This is done by search software, which can be programmed to find references to suspect transactions. The search is across all the contents of disc. Information can be recovered from investigation of free space, lost chains, slack space, deleted files, temporary Internet files etc.