INTERMEDIATE EXAMINATION

(REVISED SYLLABUS - 2008)

GROUP - II

Paper-9 : OPERATION MANAGEMENT AND INFORMATION SYSTEMS

Section I : Operation Management

Q. 1. (a) Choose the most correct alternative :

(i) Work Study aims at
   - **(A) increasing work load**
   - **(B) equitable distribution of work**
   - **(C) reducing production cost**
   - **(D) determine right man for right job**

(ii) The following establishes time sequence of operations :
   - **(A) Routing**
   - **(B) Sequencing**
   - **(C) Scheduling**
   - **(D) Dispatching.**

(iii) Lapping is :
   - **(A) Heat Treatment Process**
   - **(B) Surface Treatment Process**
   - **(C) Machining Process**
   - **(D) Extrusion Process**

(iv) Arrangement of machines depending on sequence of operations happens in :
   - **(A) Process Layout**
   - **(B) Product Layout**
   - **(C) Hybrid Layout**
   - **(D) Group Technology Layout.**

(v) SIMO Chart is used in :
   - **(A) Work Measurement**
   - **(B) Method Study**
   - **(C) Quality Control**
   - **(D) Downtime Analysis**

   (vi) Buffer stock is built to cater for
   - (A) Fluctuating load
   - (B) Machine breakdown
   - (C) Import substitution
   - (D) Diversification

   (vii) 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
   - (D) 8.37

   (viii) Continuous Improvement Programme in Japan is known as :
   - (A) Jishu Kanri
   - (B) Kaizen
   - (C) Kanban
   - (D) 5 S

   (ix) Linear Programming is a technique used for determining :
   - (A) Production Programme
   - (B) Plant Layout
   - (C) Product Mix
   - (D) Manufacturing sequence.

   (x) Cutting tools are produced from :
   - (A) High Speed Steel
   - (B) Nickel
   - (C) Cobalt
   - (D) Silica

Q. 1. (b) Fill in the blanks with appropriate word/words :

   (i) Auxilury and support facilities required to operate main production unit are called _____ .

   (ii) _____ is the interval between placing an order for a particular item and its actual receipt.

   (iii) Standard time is always _____ than normal time.

   (iv) _____ Conveyors are used for loading cement into bags in a cement plant.

   (v) VED analysis is carried out for _____ control.

   (vi) Optimum Capacity is rate of output at which there is _____ to change the size of the plant.

   (vii) Free float is _____ less slack time of the head event.

   (viii) A project implemented in the precincts of a working plant is known as _____ Project.

   (ix) Average time per cycle declines _____ with number of cycles.

   (x) Acceptance number is the maximum number of _____ items in a sample.

Answer 1. (a)

  (i) (C) reducing production cost

 (ii) (C) Scheduling

(iii) (B) surface Treatment Process

 (iv) (B) Product Layout

  (v) (B) Method Study

 (vi) (A) Fluctuating load

(vii) (C) 43.59

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

(viii) (B) Kaizen

 (ix) (C) Product Mix

  (x) (A) High Speed Steel

Answer 1. (b)

  (i) utilities

 (ii) Lead time

(iii) more

 (iv) Pneumatic

  (v) spares

 (vi) no incentive

(vii) total float

(viii) Brown Field

 (ix) exponentially

  (x) defective

Q. 2. (a) Match each item in Column A with appropriate item in Column B :

Column A		Column B	
(i)	Mortality Curve	(a)	Henry Ford
(ii)	Assembly Line	(b)	F. W. Taylor
(iii)	Scheduling	(c)	Gilbreth
(iv)	Work Study	(d)	Meredith & Gibbs
(v)	Fractionalization	(e)	Labour Cost
(vi)	Proxmimity Factor	(f)	Investment decision
(vii)	Learning Curve	(g)	Maintenance System
(viii)	FCFS	(h)	Henry Gantt
(ix)	Payback period	(i)	Prioritisation
(x)	Failure Analysis	(j)	Locational Planning

Q. 2. (b) Expand the following acronyms :

  (i) 5S

 (ii) DS/RO

  (iii) **TOT**

  (iv) **IPPS**

  (v) **CRM**

  (vi) **COPQ**

  (vii) **LTPD**

  (viii) **DNC**

  (ix) **AFTWAYS**

  (x) **AGVs**

Q. 2. (c) Indicate whether the following statements are *True/False* :

  (i) **Centrifugal pumps convert electrical energy into hydraulic energy.**

  (ii) **Rucker plan is a group incentive plan.**

  (iii) **Acceptance number is the maximum number of good items in a sample.**

  (iv) **A slack variable represents unused capacity.**

  (v) **The effective capacity is influenced by forecasts of supply.**

  (vi) **Material handling is an integral part of sales process.**

  (vii) **Annealing involves heating and cooling operations.**

  (viii) **Human Resource Planning is balancing human resources acquired and required in an organization.**

  (ix) **Labour card is prepared by dispatching department to book labour involved in each operations.**

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

Answer 2. (a)

  (i) — (d)

  (ii) — (a)

  (iii) — (i)

  (iv) — (b)

  (v) — (c)

  (vi) — (h)

  (vii) — (f)

  (viii) — (j)

  (ix) — (g)

  (x) — (h)

Answer 2. (b)

  (i) Seiri, Seiso, Seiton, Seiketsu, Shisuke.

  (ii) Dynamic Slack per Remaining Operation.

  (iii) Transfer of Technology.

  (iv) Integrated Production Planning System.

  (v) Customer Relationship Management.

  (vi) Cost Of Poor Quality.

  (vii) Lot Tolerance Percentage Defective.

  (viii) Direct Numerical Control

(ix) Always Fair Times

(x) Automated Guided Vehicles.

Answer 2. (c)

  (i) False — Centrifugal pumps convert mechanical energy into hydraulic energy.

 (ii) True.

(iii) False — It is the maximum number of defective items in a sample.

(iv) True.

 (v) False — It is influenced by forecasts of demand.

(vi) False — It is integral part of manufacturing process.

(vii) True.

(viii) True.

 (ix) False — Job card is prepared by dispatching department to book labour involved in each operations.

 (x) False — 'Z' chart is a chart used in Program Control

Q. 3. **(a) Explain how you would choose a material handling equipment from amongst alternative offers.**

  (b) Prasad 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) State the machine tool to be used for following operations :

   (i) Melting steel for making castings.

  (ii) Picking up bits of iron and steel in a scrap yard.

 (iii) Squeezing a piece of hot metal in a die.

  (iv) Making a small hole in a block of metal.

  (v) Making keyways on inside surface of the bore of a pulley.

Answer 3. (a)

The choice of material handling equipment is essentially based on technical suitability and economic considerations. In the first stage we check up whether the equipment offers meets the technical criteria/ parameters mentioned in the specification i.e the load to be lifted/carried, the speed of movement, maneuverability, turning radius etc. Once we are satisfied that the equipment meets the technical parameters , we check up the cost aspects and select the equipment having the lowest life time cost. We thus take into account the cost of initial acquisition, receiving costs incurred during the life cycle of the equipment as annual operating cost and repair/maintenance costs, and the salvage value of the equipment at the end of its life. The cash out flows and inflows occurring during the various periods are suitably discounted so as to have a common basis for comparison. While the above approach is suitable for equipments offering identical performance/output, we decide the issue on cost per unit handled, in case of equipment having differing output parameters, subject to of course their meeting the technical criteria specified.

Answer 3. (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.

Answer 3. (c)

 (i) Electric Arc Furnace.
 (ii) Electromagnet
(iii) Forging machine
 (iv) Drilling machine
 (v) Slotting machine

Q. 4. (a) What factors will have to be considered in choosing the location for the following industries?

      (i) Aluminium industry.

      (ii) Thermal power plant.

      (iii) Large furniture(domestic and office)manufacturing unit.

    (b) Empire Glass Company can produce a certain insulator on any three machines which have the following charges shown below . The firm has an opportunity to accept an order for either (1) 50 units at Rs. 20/unit or (2) 150 units at Rs. 12/unit.

Machine	Fixed Cost (Rs)	Variable Cost(Rs)
A	50	4/unit
B	200	2/unit
C	400	1/unit

    (i) Which machine should be used if 50 units order is accepted and how much profit will result?

    (ii) Which machine should be used if the 150 units order is accepted and what will be the resultant profit?

    (iii) What is the break-even volume for machine B when the price is Rs. 12/unit?

    (iv) Suppose the fixed cost for machine A is a stepped function with Rs. 50 up to 40 units and Rs. 100 thereafter. Will the answers to (i) and (ii) above vary? If so, what will be the revised answer?

Answer 4. (a)

The general factors to be considered for any Industry location are the following :

1. Proximity to raw material sources
2. Availability of critical input required for the process
3. Proximity to the Market
4. Availability of skilled labour
5. Special tax and other financial benefits available in a location
6. Central/state/municipal regulations.

While all the above factors are important for all Industries, some factors will be dominant for some industries as explained below :

1. **Aluminium Industry** is a power intensive industry. Hence the region/location where availability of power is a very critical consideration for the choice of location.

   Likewise, proximity to raw material source namely bauxite is also a vital consideration.

2. **For thermal plant** proximity to coal mines is very important since transportation of huge quantity of coal every day is very costly and difficult. Equally important is the availability of abundant quality of water for the boiler.

3. **For furniture industry** proximity to the Market is a crucial factor apart from other factor. While transporting finished furniture, damages may take place and also it will be bulky and occupy more space and hence costly. Therefore furniture units are located nearer towns and cities nearer to offices and houses.

Answer 4. (b)

(i) For 50 unit order at Rs. 20/unit.

Costs for various machines :

Machine		Rs.	Profit	Rs.
Machine A	50 + 50 × 4 =	250	1000 – 250	750
Machine B	200 + 50 × 2 =	300	1000 – 300	700
Machine C	400 + 50 × 1 =	450	1000 – 450	550

Since Machine A gives the highest profit of Rs. 750 it is to be preferred.

(ii) For 150 unit order at Rs. 12/unit.

Costs for various machines

Machine		Rs.	Profit	Rs.
Machine A	50 + 150 × 4 =	650	1800 – 650	1,150
Machine B	200 + 150 × 2 =	500	1800 – 500	1,330
Machine C	400 + 150 × 1 =	550	1800 – 550	1,250

Hince Machine B to be preferred.

(iii) Breakeven Volume for Machine B at Rs. 12/unit.

Let X be the No. of units to be produced.

Total costs at 'X' units = 200 + 2x

Total revenue at x units = 12x.

At Breakeven point.

$$200 + 2x = 12x$$

i.e $10x = 200$

$\underline{\ \ x = 20\ \ }$

Hence 20 units is the Breakeven Volume.

(iv) The fixed cost for machine A being a step function, the total cost of manufacturing of 50 units with machine.

A = 100 + 50 × 4 = Rs. 300, which is also the cost of production with machine B. Thus either of the two machines A or B could be chosen to produce 50 units.

A will be Rs. 700, which is higher than the production cost on machine B.

Hence the answer in this case will not vary.

Q. 5. (a) '**Technology as an aspect of production of the goods/services is the domain of the production engineer and as such the operations manager should stay clearly away from this. He need not have any specialized knowledge or appreciation of the technology.' Do you agree or disagree with this statement?**

Justify your answer.

(b) **A Company adopts a counterseasonal product strategy to smooth production requirements. It manufactures its spring product line during the first four months of the year and would like to employ a strategy that minimises production costs while meeting the demand during these four month. The Company presently has on its rolls, 30 employees with an average wage of Rs. 1,000 per months. The Company presently has on its rolls, 30 employees with an average wage of Rs. 1,000 per month. Each unit of the product requires 8 man-hours. The Company works on single shift basis (8 hrs. shift/day). Hiring an employee costs Rs. 400 per employee per occasion and discharging an employee costs Rs. 500 per person per occasion. Inventory carrying costs are Rs. 5/unit/month and shortage costs are Rs. 100/unit/month and shortage costs are Rs. 100/unit/month. The Company forecasts the demand for the next four months as below :**

Month	(Demand units)	No. of working days in the month
January	500	22
February	600	19
March	800	21
April	400	21

The Company is thinking of adopting one of the following pure strategies :

Plan I : **Vary work force levels to meet the demand.**

Plan II : **Maintain 30 employees and use inventory and stockouts to absorb demand fluctuations.**

Which strategy would you recommend? You may assume nil inventory at the start.

Answer 5. (a)

Operations managers need to understand the technology of the process. The extent to which they will need to appreciate the engineering/technology base in order to contribute to it will vary. However it is essential in all situations that the operations managers should understand the process in terms of the following :

1. The relationship between set-up time and process time so as to help choose between options by using the break-even concept :

   Break-even Additional setting up time for a process.

   Reduction in process time per unit of product service.

2. The operating requirements of each process including loading, unloading, maintenance, and waste by-products created

3. The different dimensions of flexibility including the ability to :

   (a) produce part or all of the current/anticipated range of products services ;
   (b) respond to increases in demand on a time scale that cannot be met by the purchase of additional process capacity ;
   (c) meet delivery promises leading to a high level of both delivery speed and reliability;
   (d) cope with customer specification changes during the process ;
   (e) choose between different sets of processes, equipment to achieve a high level of compatibility in facilities, tools, dies and other auxiliary equipment.

4. The possible impact upon the definition of a product service by the technical capability of the process. For example, direct access by computers within the travel industry allows for parts of the booking in procedure to be completed before the day (e.g. seat reservations) and affords the opportunity to list options in parts of the services such as alternative routes.

5. The introduction of technology into all facets of the operations timetion will lead to changes in terms of skill requirements and staff mix.

6. Technology creates the opportunity for change, but if the basis of a business is to change fundamentally it must be driven by customer need and not by technology.

7. The process has to be able to meet the product/service specification. Furthermore, when evaluating process investments, companies need to distinguish between process capability features accruing from the fact that the process under review will be new whereas the one it replaces may be old and unable to meet the specification demands due to wear and tear and those features accruing from the fact that it is state of the art offering new and relevant capabilities.

8. Technology may result in both barriers to entry on the one hand and ease of access on the other. The investment skills support requirements are well understood. However, if offers access to others, for example airlines are increasingly moving into the 'booking' phase of then business as telephone/ computer access obviates the need for a high stress presence.

Answer 5. (b)

The overall costs of both the strategies are computed in the following tables.

Plan I, varying the work force levels to suit the production needs :

	January	February	March	April	Total
1. Workers required	$\frac{500}{22} = 23$	$\frac{600}{19} = 32$	$\frac{800}{21} = 38$	$\frac{400}{21} = 19$	
2. Labour cost	23,000	32,000	38,000	19,000	1,12,000
3. Hiring costs		9 × 400 = 3,600	6 × 400 = 2,400		6,000
4. Lay off costs	7 × 500 = 3,500			19 × 500 = 9,500	13,000
				Total	1,31,000

Plan II : Maintain a steady work force and use of inventory plus stock on

	January	February	March	April	Total
1. Workers used	30	30	30	30	
2. Labour cost	30,000	30,000	30,000	30,000	1,20,000
3. Units produced	660	570	630	630	
4. Inventory costs	5 × 160 = 800	5 × 130 = 650		5 × 190 = 950	2400
5. Shortage costs			100 × 40 = 4,000		4,000
				Total	1,26,400

On the basis of costs, plan II would be the choice. Moreover this strategy would result in higher worker morale, smoother production, and generally, a higher quality product.

Q. 6. (a) 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 theoritical minimum number of stations required to meet a forecasted demand of 400 units per an 8-hour day?

(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

(b) Write short notes on :

(i) Line Balancing

(ii) Work Simplification

(iii) Progressing

(iv) Six Sigma quality programme

Answer 6. (a)

(i) **Schematic Diagram :**

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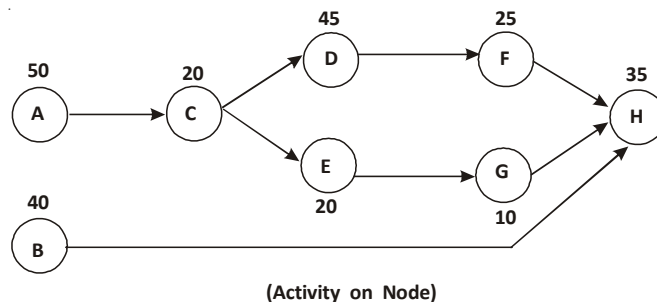
(ii) Theoretical minimum number of stations to meet D = 400 is :

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

$$= 245 \div 72$$

$$= 3.4 \text{ day } 4.$$

(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) × 100 = 87.5%

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

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

Answer 6. (b)

(i) This technique is employed to ensure balanced flow of production specially in Assembly lines. When products require a number of operations to be performed , the time taken for each operation may vary. Therefore if the line is not balanced , a few operators will be over loaded whose operation times are long and others will be idling away their time.

This technique decides the cycle time for the products based on the output required per shift. This also considers the sequence in which the operations will have to be carried out. Then Line Balancing technique groups operations in such a manner that each group will have generally equal total task times. Each group is called a work station and assigned to an operator. Thus all the operators in each work station will have balanced load.

(ii) 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.

(iii) Progressing is the gentle but firm direction of 'activities planned' to proper channels, shielding them from adverse factors inseparable from actual operations. The work of the progress department starts where the planner's ends. The Progress Controller/Progress Chaser , as he is called, is not concerned with methods of carrying out operations(which are under the purview of the process planning department) but the 'doing' of them at proper time in the correct order and at the lowest anticipated cost. The duties of the Progress Chaser would vary widely from unit to unit. In a well organized manufacturing activity, his duties consists of :

(A) recording of actual production or output against planned production;

(B) assessment of causes leading to activities falling behind schedule;

(C) reporting to appropriate authority;

(D) where possible , to foresee all that may lead to failure on schedules and to sound a note of warning to all concerned.

(iv) 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.

Q. 7. (a) Explain the need for acceptance sampling.

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

(c) The following cost have been recorded :

Particulars	*Rs.*
Incoming materials inspection	**10000**
Training of personnel	**30000**
Warranty	**45000**
Process planning	**15000**
Scrap	**9000**
Quality laboratory	**30000**
Rework	**25000**
Allowances	**10000**
Complaints	**14000**

What are the costs of prevention, appraisal, external failure and internal failure?

Answer 7. (a)

Acceptance sampling is a technique which helps us to decide on the quality of incoming products and in deciding whether to accept or reject the lot, based on a test of samples. In absence of this technique, we would have to resort to 100% inspection of the lot. The 100% inspection alternative is however costly and time consuming. Also 100% inspection does not guarantee that the outgoing products are of good quality, because of monotony and possibility of human errors. Again 100% inspection cannot be used when ever the type of test for acceptance of the product is of destructive type. Under these circumstances , we have to necessarily resort to acceptance sampling.

Answer 7. (b)

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. Every body 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.

Answer 7. (c)

Particulars	Rs.
Training of personnel	30000
Process planning	15000
Total cost of **prevention**	45000
Incoming materials inspection	10000
Quality laboratory	30000
Total cost of **appraisal**	40000
Scrap	9000
Rework	25000
Total cost of **internal failure**	34000
Warranty	45000
Allowances	10000
Complaints	14000
Total cost of **external failure**	67000

Q. 8. (a) A learning curve has strategic implications. Discuss.

(b) It is not worthwhile to improve the productivity when the industry is facing recession leading to reduction in profits. Comment.

(c) An industrial engineer, deputed to conduct a time study for a job, has, after observation, divided the job into 5 elements. He had noted the timings for four cycles of the job as below :

(Time in mins.)

Element	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Performance rating
1	1.246	1.328	1.298	1.306	90
2	0.972	0.895	0.798	0.919	100
3	0.914	1.875	1.964	1.972	100
4	2.121	2.198	2.146	2.421	110
5	1.253	1.175	1.413	2.218	100

> **(i) Are there any outliers in the data, i.e., probable errors in reading or recording data which should not be included in the analysis?**
>
> **(ii) Compute the basic time for the job and the standard time if a relaxation allowance of 12%, a contingency allowance of 3% and an incentive allowance of 20% are applicable for the job.**

Answer 8. (a)

The learning curve is particularly important in productivity improvement results during the rapid development and mature phases of the product life cycle. Its uses in strategic planning is discussed below :

(i) A firm which has the largest market share will produce the largest number of units and will have the lowest cost, even if all the firms are on the same percentage learning curve.

(ii) If through process technology advantages, a firm can establish itself on a lower percent learning curve than a competitor, it will have lower unit cost, even if both firms have the same cumulative output.

(iii) A firm with greater experience can use an aggressive price policy as a competitive weapon.

(iv) A firm can use aggressive process technology policy by allocating resources towards mechanization in earlier stages and automation in the later stages of growth to maintain its position.

Answer 8. (b)

This statement is not correct. Productivity improvement has to be constantly done in industry. While productivity improvements during periods of economic boom can lead to greater profits, productivity improvement during economic recession, is all the more necessary for cost reduction and lesser losses. With improved productivity, the unit cost of production is reduced, thereby minimizing the losses in such a situation. Put in other words, a company would end up with longer losses, if it does not care to improve productivity during recessionary periods.

Answer 8. (c)

(i) Element 3 in cycle 1 and element 5 in cycle 4 primafacie appear to be outliers and may not be considered in standard computation.

(ii) **Computation of standard time.**

Element	Arithmetic Average of observed time	Rating	Basic time	Remarks
1	1.2945	90	1.165	—
2	0.8960	100	0.896	—
3	1.9370	100	1.937	time for cycle 1 not considered
4	2.2215	110	2.444	—
5	1.2800	100	1.280	time for cycle 4 not considered
			7.722	

Basic time   = 7.722 mins

Allowance   = (12+3)   = 15% (Incentive allowance not considered)

Standard time = 7.722 × 1.15 = 8.88 min (approx)

Q. 9. (a) Define work sampling. Write down the formula indicating terms used for determining the sample size.

(b) Under what circumstances would work or activity sampling be preferable to time study for developing labour standards?

(c) A work sampling study is to be made of a data entry operator pool. It is felt that operators are idle 30% of the time. How many observations should be made in order to have 95.5% confidence that the accuracy is within +/- 4%.

Answer 9. (a)

Work sampling is a work measurement technique in which a sufficient large number of instantaneous observations of an worker or machine are taken over a period of time to obtain a reasonably accurate picture of the time spent on different activities. It is based on statistical theory of sampling. Work sampling is thus a method of finding out percentage occurrence of a certain activity or delay by statistical sampling.

The procedure of work sampling consists of following steps :

  (i) The purpose of study to be determined first.

 (ii) The worker or machine to be identified.

(iii) The operations to be observed to be decided.

(iv) The number of observations to be made to be decided.

 (v) The activity performed at each visit to be recorded.

(vi) Percentage of total time spent on each activity to be calculated.

(vii) Standard time is established by adding allowances.

The formula deciding the sample size is as follows :

$$n = \{4p(1-p)\}/s^2 \text{ where,}$$

n = sample size

p = extent of activity being observed.

s = accuracy of sample results.

Answer 9. (b)

Time study calls for qualified time study engineer or rate setter recording the time for an activity over time. For predetermined time setting, detailed process sequencing and corresponding time for each process has to be computed. The advantages of work sampling over time study are as follows :

  (i) Studies of several operators and machines can be done simultaneously.

 (ii) No trained time study personnel are required.

(iii) No timing equipment required.

(iv) Long cycle work may be studied with fewer observer hours.

 (v) The study may be interrupted at any time without any adverse consequences.

(vi) Operator can not influence results as he is not aware as to the precise timing at which he would be observed.

(vii) Also he tends to perform naturally as he does not get the feeling of someone breathing down his neck as in the case of time study where the operator is watched continuously.

Answer 9. (c)

$n = \{4p(1-p)\}/s^2$

$p = 0.3$

$1-p = 0.7$

$s = 0.04$

$n = 4 \times 0.3 \times 0.7/(.04)^2$

$= 0.84/.0016$

$= 525.$

Q. 10. (a) Data regarding materials used by a certain manufacturing unit is furnished below :

Item code	Unit cost Rs.	Annual consumption (Units)
3637	1.20	6850
8061	8.60	371
3195	13.18	1292
2321	91.80	62
4023	3.20	12667
4094	10.18	9625
4881	1.27	7010
3121	0.88	5100
6846	62.25	258
8355	18.10	862
1726	0.38	1940
0093	2.20	967

The management classifies items accounting for the top 71% (approx.) of the total annual cash outflow on this account as A category and items accounting for the bottom 7.5% of the annual cash outflow as C category and the remaining as B category items. It follows a policy of quarterly ordering for A category items, half-yearly ordering for B items and annual ordering for C items. Calculate the annual variable cost of this policy if the cost of ordering is Rs. 200 per order and the annual inventory carrying cost is 25%. Assume that each item is supplied by a separate supplier.

The management now wishes to change the ordering system, in respect of A category items to a fixed quantity variable interval system, based on EOQ, while continuing with the existing practice in respect of B & C items. What would be your recommendation?

(b) High Morale Co. Ltd. has introduced a Scanlon Plan of Incentive Bonus for its employees from 2011. The relevant information for the three previous years are as follows :

Year	Sales Revenue Rs.	Total Salaries & Wages Rs.
2008	24,00,000	6,00,000
2009	25,00,000	5,00,000
2010	27,00,000	6,00,000

For 2011 the Sales Revenue has been Rs. 30,00,000 and Rs. 6,00,000 has been paid as salaries and wages. The features of the scheme are that 30% of the cost savings is set aside in a bonus equalisation revenue fund and that the balance is shared by the management and employees in the ratio of 1 : 2.

Calculate the bonus payable to an employee whose monthly salary was Rs. 4,000 during the year 2011.

Answer 10. (a)

Computation of consumption value

Item code	3637	8061	3195	2321	4023	4094	4881	3121	6846	8355	1726	0093
Consumption value (Rs.) (rounded off)	8220	3191	17029	5692	40534	97982	8903	4488	16060	15602	737	2127
Revised Serial in descending order	7	10	3	8	2	1	6	9	4	5	12	11

**Tabulation in the descending order of
consumption value for ABC Classification**

Sl. No.	Consumption Value in (Rs.) (more than)	Cumulative value (Approx)	% - age of Total	Item Category	Comments	Item code
1	97,982	97,982	44.44	A	Sl. 1, 2, 3	4094
2	40,534	1,38,516	62.8	A	Constitutes apx. 71%	4023
3	17,029	1,55,545	70.5	A	of total value	3195
4	16,060	1,71,605	77.8	B	Balance "B" items	6846
5	15,602	1,87,207	84.9	B		8355
6	8,903	1,96,110	88.9	B		4881
7	8,220	2,04,330	92.6	B		3637
8	5,692	2,10,022	95.2	C	Sl. 8 to 12	2321
9	4,488	2,14,510	97.3	C	accounts for	3121
10	3,191	2,17,701	98.7	C	bottom 7.5% of	8061
11	2,127	2,19,828	99.7	C	consumption value	0093
12	737	2,20,565	100	C		1726

Computation of annual variable cost under the existing policy :

Annual variable cost (relevant portion only) = Ordering cost + Inventory carrying cost
= No. of orders × Ordering cost per order + Inventory carrying cost.

For A items (No. of orders 4)

For item 4094 $= 200 \times 4 + \dfrac{9625}{4 \times 2} \times 0.25 \times 10.18$

For item 4023 $= 200 \times 4 + \dfrac{12667}{4 \times 2} \times 0.25 \times 3.2$

For item 3195 $= 200 \times 4 + \dfrac{1292}{4 \times 2} \times 0.25 \times 13.18$

Total $= 200 \times 4 \times 3 + (9625 \times 10.18) + 12667 \times 3.2 + 1292 \times 13.18) \times \dfrac{0.25}{4 \times 2}$

$= 2400 + 155545 \times \dfrac{0.25}{4 \times 2} = 2400 + 4861$ (approx).

For B items $= 4 \times 2 \times 200 + (16060 + 15602 + 8903 + 82220) \times \dfrac{0.25}{2 \times 2}$

(No. of orders 2) $= 1600 + 3049$ (approx.)

and **for C items** $= 5 \times 200 + (5592 + 4488 + 3191 + 2127 + 737)$

(No. of orders 1) $= 1000 + 2029$ (approx.) $\times (0.25 \div 2)$

Total $= 5000 + 9939 = $ Rs. 14939 (approx.)

EOQ for A category items may be computed as —

$$EOQ = \sqrt{\dfrac{2 \times \text{Annual consumption in units} \times \text{Ordering cost/unit}}{\text{Inventory carrying cost}}}$$

Computing EOQs for three items are :

Item code	4094	4023	3195	Total
EOQ (approx)	1300	2517	396	—
No. of orders nearest whole number	8	5	4	—
Ordering cost (Rs.)	1600	1000	800	3400
Inventory Carrying cost * (Rs.)	1654	1007	652	3313

$* \dfrac{(1300 \times 0.25 \times 10.18)}{2}$

Present cost for A items $= 2400 + 4861 = $ Rs. 7261

New cost for A items $= 3400 + 3313 = $ Rs. 6713

Savings Rs. 548

Since the company stands to gain in the new system, change over is recommended.

Answer 10. (b)

(Rs. in lacs)

Year	Sales revenue	Total Salaries and wages	Salary and wages as % of sales
2008	24	6	25.00
2009	25	5	20.00
2010	27	6	22.22
Sub-total	**76**	**17**	**22.37**

Expected salary and wages based on last three years average.

2011	30	6	6.711

Computation of Incentive

Savings 6.711 – 6.0	=	0.711 lacs
30% of it in bonus Equalisation Fund	=	0.2133 lacs
Balance	=	Rs. 0.4977 lacs
Payable to management (1/3)	=	0.1659 i.e. Rs. 16,590
Payable to employees (2/3)	=	0.3318 i.e. Rs. 33,180
Sub-total	=	0.4977 i.e. Rs. 49,770

Computation of incentive payable to an employee whose monthly salary is Rs. 4,000

Total salary & wages (Rs.)	Incentive amount (Rs.)
For 6,00,000	33180
For 4,000 × 12	$\dfrac{33,180 \times 4,000 \times 12}{6,00,000}$ = Rs. 2654.40

Q. 11. (a) Five jobs have to be processed through two machines 1 and 2 sequentially. The table below gives the processing times in hours :

Job	A	B	C	D	E
Machine 1	2	7	5	6	5
Machine 2	4	8	6	7	3

  (i) What is the minimum total time for completion of all jobs?

 (ii) For what period, if any, Machine 2 remains idle?

(iii) When does Job D gets completed?

(b) The company is engaged in the assembly of a wagon on a conveyor. 500 wagons are required per day. Production time available per day is 420 minutes. The other information is given below regarding assembly steps and precedence relationships. Find the minimum number of work stations, balance delay and line efficiency.

Answer 11. (a)

A *n* jobs through two machines sequencing model for the given problem is given below :

  Step 1: To find out minimum processing time on machine 1. It is 2 hours.

  Step 2 : Next minimum is for job E in machine 2. So it will be taken at the end.

  Step 3 : Next comes D and then B. Processing in machine 2 follows completion in machine 1.

Machine 1

0		2		7		13		20		25
A		C		D		B		E		

Machine 2

	2		6	7		13		20		28		31
		A			C		D		B		E	

<div align="center">Time in hours</div>

From the above figure we can easily find—

   (i) Minimum total time for completion of all jobs=31 hours.

  (ii) Machine 2 remains idle for 3 hours(hatched portion)

 (iii) Job D gets completed on 20th hour.

Answer 11. (b)

The element times and precedence relationships

Task	Time (sec)	Task that must Precede
A	45	–
B	11	A
C	09	B
D	50	–
E	15	D
F	12	C
G	12	C
H	12	E
I	12	E
J	08	F, G, H, I
K	09	–
Total	195	–

   (i) Precedence diagram is constructed as per the given details.
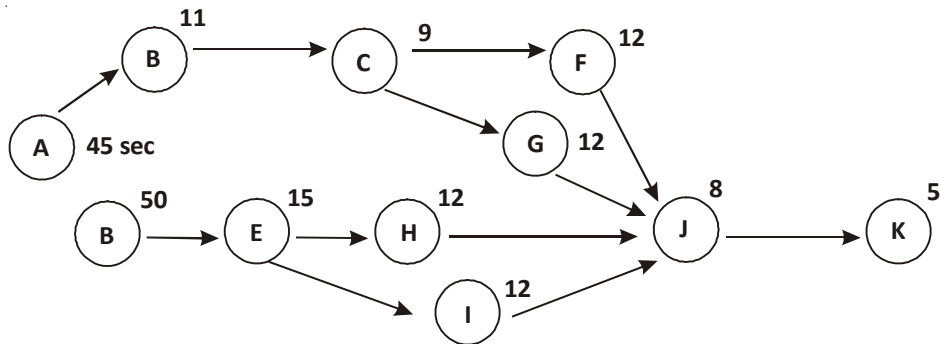
  (ii) Determination of cycle time

$$C_t = \frac{\text{Production time / day}}{\text{Output / day}} = \frac{420 \times 3}{500} = \frac{25,200}{500} = 50.4$$

 (iii) Theoretical number of work stations required

$$N = \frac{\text{Total time}}{\text{Cycle time}} = \frac{195}{50.4} = 3.87 \approx 4 \text{ workstations}$$

 (iv) Assign the elements to work stations based on the largest element time and the work stations to be required are 5.

Balance made according to largest number of followers task rule.

Station	Task	Task time (sec)	Idle time (sec)
S_1	A	45	5.4
S_2	D	50	0.4
S_3	B	11	3.4
	E	15	
	C	09	
	F	12	
S_4	G	12	6.4
	H	12	
	I	12	
	J	8	
S_5	K	9	41.4

(v) Efficiency $= \dfrac{T}{\text{No. of stations} \times C} = \dfrac{195}{5 \times 50.4} \times 100 = 77.38\%$

(vi) Balance delay = 100 − 77.38 = 22.62%

Q. 12. (a) 'As is common to other functional areas in management, maintenance management activity involves decision making.' Elaborate this statement and identify some areas of decision making in the maintenance function.

(b) The probabilities of failure p_n of an equipment in the nth period after maintenance have been estimated as follows :

n	1	2	3	4
p_n	0.1	0.2	0.4	0.3

Cost of preventive maintenance   : Rs. 150
Cost of breakdown maintenance : Rs. 1000
Determine the optimum frequency of preventive maintenance.

Answer 12. (a)

The areas of decision making in the maintenance function may be broadly discussed as :

(i) Type of maintenance to be followed i.e whether preventive maintenance , corrective maintenance, design out maintenance or a combination of all of them will be most suitable.

(ii) The systems and procedures to be incorporated to effectively plan, control and monitor the system.

(iii) Proper classification and codification of assets.

(iv) Maintenance crew requisition system.

(v) Spare parts inventory control.

(vi) Subcontracting of the maintenance work or in-house maintenance.

(vii) Repair versus replacement.

(viii) Group versus individual replacement.

(ix) Number and types of standby equipment.

(x) Planning of in-house repair capacity keeping in mind the vagaries of maintenance work.

Answer 12. (b)

(i) It has been assumed that equipments that fail are replaced just before end of the week.

(ii) Actual percentage of failures during the period for equipments of same age is same as the expected percentage of failure during the period for them.

Period	Prob. Of failure p_n	No. of replacements made at the end of nth period.	Cost of breakdown maintenance	Cost of preventive maintenance	Total cost mainte-nance	Cost per period
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	0.1	0.1	0.1*1000 = 100	150	250	250
2	0.2	0.2+(0.1*0.1)= 0.21	0.21*1000 = 210	150	250+ 210 = 460	460/2= 230
3	0.4	0.4+(0.21*0.1) + (0.1*0.2) = 0.4+0.021+0.02= 0.441	0.441*1000 = 441	150	460 + 441= 901	901/3 = 300.3

Therefore optimum frequency of preventive maintenance is once in 2 periods and expected cost of maintenance is Rs. 230.

Q. 13. **A company has three plants F$_1$, F$_2$ F$_3$ from which it supplies to 4 markets: ABCE. Determine the optimal transportation plan from the following table giving the plant to market shipping costs, quantities available at each plant and quantities required at each market.**

Plant	Markets				
	A	B	C	D	Available at plant
F$_1$	13	11	15	20	2
F$_2$	17	14	12	13	6
F$_3$	18	18	15	12	7
Requirement	3	3	4	5	15

Answer 13.

The problem is balanced transportation problem because the demand and supply both are equal to 15. Now obtain the initial feasible solution by Vogel's method. The cost matrix and the penalties for given problem are as under :

Factory		Warehouses Markets			Avail-ability	Row Penalty
	A	B	C	D		
	(1)	(2)	(3)	(4)		
F1	13	11	16	20	2	(13 –11) = 2
F2	17	14	12	13	6	(13 – 12) = 1
F3	18	18	15	12	7	(15 – 12) = 3
Amount required	3	3	4	5	15	
Column penalty	(17–13)= 4	(14–11) =3	(15 - 12) =3	(13 – 12)=1	—	—

Now, penalty of first column is maximum and the lowest cost in column (1,1), i.e., Rs. 13, so allocate 2 units (maximum quantities available in F,) to cell (1,1) and delete row (1) as its requirements is complete.

Now penalty of column (2) is maximum and the lowest cost is 14 so, we can allocate 3 units to cell (2,2) as 3 units are the maximum requirement for market B. The requirement of column (2) is exhausted hence column (2) is deleted. The shrunken matrix becomes as—

Factory	Warehouse			Availability	Penalty
	(1)	(3)	(4)		
F_2	17	12	13	3	1
F_3	18	15	12	7	3
Requirement	1	4	5	10	
Penalty	1	3	1		

Now, we consider earlier row(3)or column(3)because both have minimum cost of Rs. 12. Let us consider column (3) and allocate 3 units to cell (2,3) and delete row F_2. Now the balance will be allocated to row F_3. Thus, the initial solution by Vogel's method is given in the following table :

Factory	Warehouse				Availability
	A	B	C	D	
F_1	2	–	–	–	2
F_2	–	3	3	–	6
F_3	1	–	1	5	15
Requirement	3	3	4	5	7

Here m + n – 1 = 6 equal to the occupied cells hence solution is feasible. Now, the optimality can be tested by calculating the implicit cost for each cell. The calculations are given below :

Factory	Warehouse												Availability
	A				B			C			D			
F_1	13			11			15			20				
		13			11			9			7	2		–5
F_2	17			14			12			13				
				2			4					6		–2
		16			14			12			10			
F_3	18			18			15			12				
		2			29						5		6	
		12			15			14			12			
Requirement		3			3			4			5		15	
V_j		18			16			14			12			

In the above table in cell 1,2, the implicit cost is greater than the actual cost hence 8 units' are allocated to (we get the following solution) :

Factory	Warehouse				Availability
	A	B	C	D	
F_1	$2-\theta$	θ	–	–	2
F_2	–	$3-\theta$	$3+\theta$	–	6
F_3	$1-\theta$	–	$1-\theta$	5	7
Required	3	3	4	5	15

In the above table, the minimum of negative q is one hence take q=1 and get the revised solution and test the optimality again with the help of the following table:

Factory	Warehouse												Availability
		A			B			C			D		
F_1	13	2	13	11		12	15		10	20		17	–5	2
F_2	17		15	14	3	14	13		9				–3	6
F_3	16		18	18		17	15		15	12	5	12	0	7
V_j		18			17			15			12			
Required		3			3			4			5			15

Thus, it can be observed from the above table that implicit cost for all cells is less than the corresponding actual costs. Hence the improved solution is optimal and the minimum cost is Rs. 156 as under

Transportation cost

$F_1A = 11 \times 1 = 13$

$F_1B = 11 \times 1 = 11$

$F_2B = 14 \times 2 = 28$

$F_2C = 12 \times 4 = 48$

$F_3A = 18 \times 2 = 36$

$F_3D = 12 \times 5 = \underline{60}$

Rs. $\underline{196}$

Q. 14. (a) What is Delphi technique? What is its applicability in a manufacturing organization?

(b) What is Technology Life Cycle?

Answer 14. (a)

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.

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

Answer 14. (b)

Technology Life Cycle comprises of 4 stages, viz., Innovation, Syndication, Diffusion and Substitution.

(i) **Innovation :** This stage , in turn, comprises of three stages, namely Intelligence, Design and Choice.

Intelligence stage involves creation of a product or technology through pure research, applied research, market research, brain storming etc., and selection through preliminary screening and feasibility analysis.

Design stage : involves development of the process or technology through which the concept could be given shape and Design and Testing are then done before final launching /adoption. Choice of the desired product/technology paves the way for finally launching the same in the market.

(ii) **Syndication :** During this stage, the technology/product is demonstrated and slowly commercialized.

(iii) **Diffusion :** In this stage, the new technology slowly penetrates and replaces the old one.(E.g. Pentium chips have replaced 486 and the colour TV have phased out the Black & White T.V)

(iv) **Substitution :** Substitution comes in when the cycle is complete and original technology is completely replaced by the advanced one(e.g the valve set radio no more exits.)

Q. 15. Liberalisation has led to frantic cries and poignant appeals for creation of a 'level playing field' by some of the existing players in the field. In the ultimate reckoning, however, competition is a reality that cannot be wished away and has to be faced /countered. Examine this issue in the context of operations management and outline a few approaches adopted by the leading players in the market to retain their position and also improve upon the same in face of competition.

Answer 15.

In economic activities pertaining to industry, a level playing field under scores the need of having an impartial outlook in all the operational aspects of the players in the fray. While it is difficult to definitely come to a consensus about such a situation, Indian Industries, particularly after liberalization, have been crying hoarse to have a situation which will—

(i) not give any undue advantage to a foreign player in terms of fiscal and monetary benefits in lower tax rate, higher interest on their deposit, easier accessibility to capital and money market- both domestically and internationally;

(ii) give them some breathing time to cope up with the financial ,technological and managerial muscles of the MNCs/TNCs . This is particularly relevant keeping in view the tentacles of MRTPA, CCI and IDRA which had hitherto prevented the Indian Companies to grow to a level commensurate to their global peers/competitors.

Nevertheless, all the forward looking companies have accepted globalization as an irreversible process and have been tightening their belts and gearing their activities up to meet the challenges of competition.

As we know, operation management cuts across all three areas of management i.e strategic planning, management control and operational control. It also takes a holistic view about the functional parameters. However, the areas mainly covered are that of production, maintenance, planning, materials, human resource development, logistics(internal and external), capacity, quality, capital expenditure etc. The approaches that are commonly discernible in these areas may be discussed under the following heads :

(i) **Strategy :** Leading companies take a long range view of developing markets, customers and capabilities rather than just keep a track of quarterly earnings. The company should try to select good long term market and to be in business in which it can compete successfully. After identifying

appropriate short and long term goals, the company should identify all capabilities that will need to achieve them and then develop or acquire missing ones. They identify their core competencies and follow either a cost leadership or product differentiation strategy.

(ii) **Product design :** Leading companies take the customers' view in product development and improvements. The goal is to understand the customer needs and to have products that are appealing and also serve the needs effectively, economically and efficiently to give them value for their money. Faster product development times are sought. Concurrent engineering is used in the high cost design segment, to design production processes and products that are compatible and cost effective. The representatives from marketing, purchasing, quality, manufacturing and field service jointly review the subject and look for designs that have customer appeal, cost effective materials, ease of production and assembly, durability and reliability. Good design simplifies products which use as few parts as necessary and also parts which are in common with other models.

(iii) **Technology, Processes and Equipment :** Leading companies seek suggestions from equipment suppliers, employees and process engineers towards continuous improvement and attempt to simplify the processes. Simpler processing equipment is more easy to maintain and more reliable. Simpler processes are easier to learn and need less co-ordination efforts. These companies are also willing to spend money on maintenance and replacement to upgrade the equipment so as to ensure quality and reliable deliveries.

(iv) **Logistics Arrangement and layout :** Leading companies remove what is not needed, organize the rest and arrange them neatly. Tools often used are located together and invariably colour coded to facilitate easy identification. Inventories of components are also kept near the points of use. Equipments are grouped into manufacturing cells. Production items flow through these cells in small quantities or single items so that WIP is kept low. This reduces space requirements also. Efforts are also taken to reduce the cost of external logistics eg. insurance, warehouse, transportation etc.

(v) **Production Planning and Control Systems :** WIP is reduced by employing JIT techniques. Also , rapid set ups are resorted to, leading to less throughput time. As queues of WIP are reduced , and with lesser throughput time, the forecast horizon becomes shorter and the company becomes more responsive to market changes. Less inventory on the shop floor allows people and equipment to be located closer together to facilitate coordination by sight. Simplification and data automation are used to reduce paper work. Customized mass production is also resorted to harness the market perception.

(vi) **Human Resource Development :** Training and development of human resources is an important activity. This facilitates better team work operation of self –directed teams. The employees' participation is encouraged. Also the number of layers of management between the top management and frontline worker is reduced. The employees are given broadened responsibilities and participate in decisions and improvement activities. Qc and TQM are found to be quite useful for the purpose.

(vii) **Quality :** Often it is less expensive to make items correctly the first time, than to make them over. In the face of pressure of delivery times and budget, the companies tended to amend the symptoms of the problem rather than solving its root cause. The scene has now changed to devoting more attention to understanding the causes of problems and correct the weakness. Quality improvement programmes of the leading companies have invariably led to design and process improvement, employee training, supplier programme and above all, a careful look at the customers' requirements. Team work and quality consciousness are enhanced by instilling in employees that what one employee works on is his customer and so on till the external customer.

Section II : Information Systems

Q. 16. (a) Choose the most appropriate answer from the four alternatives in the set :

  (i) **Which of the following is NOT an operating system?**
      (A) **OS/2**
      (B) **Win XP**
      (C) **Oracle**
      (D) **UNIX**

  (ii) **A network topology where all computers are connected to a central hub is called :**
      (A) **Ring**
      (B) **Bus**
      (C) **Star**
      (D) **Token**

  (iii) **Assembly language is :**
      (A) **Machine dependent**
      (B) **Machine independent**
      (C) **Partly dependent and partly independent**
      (D) **Not a programming language**

  (iv) **"Nanosecond" is :**
      (A) **millionth of a second**
      (B) **$1/1000^{th}$ of a millionth of a second**
      (C) **$1/100^{th}$ of a millionth of a second**
      (D) **$1/10^{th}$ of a millionth of a second**

  (v) **'Packet switching' on the Internet refers to :**
      (A) **Type of circuitry**
      (B) **Switching components**
      (C) **Method of data movement**
      (D) **Packet of hard copy of documents.**

  (vi) **A common coding language for the www is :**
      (A) **HTML**
      (B) **Front page**
      (C) **Netscape**
      (D) **Listserver.**

  (vii) **Barcode is :**
      (A) **Unit used in banking industry**
      (B) **Universal product code**
      (C) **Spreadsheet package**
      (D) **Scan graphs.**

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

    (A) Tape Drive

    (B) Disk Pack

    (C) Compact Disk

    (D) Daisy Wheel Printer.

(ix) Tree topology is :

    (A) Combination of BUS topologies

    (B) Combination of RING topologies

    (C) Combination of STAR topologies

    (D) None of the above.

(x) 'Firmware' is associated with :

    (A) Application software for firms.

    (B) Special purpose hardware device.

    (C) Benchmark software.

    (D) Software in ROM.

Q. 16. (b) Expand the following abbreviations :

    (i) ISAM

    (ii) SET

    (iii) MDR

    (iv) RADIUS

    (v) APRANET

    (vi) RISC

    (vii) VRML

    (viii) HTTP

    (ix) WYSIWYG

    (x) WAIS

Q. 16. (c) Match Column I with relevant terms in Column II.

Column I	Column II
(i) FTP	(A) Measure of processing performance
(ii) MIPS	(B) Provides information about location of a document
(iii) LCD	(C) Secondary storage
(iv) URL	(D) Communication protocol
(v) IBG	(E) Communication between two pieces of hardware
(vi) Handshaking	(F) Hierarchical data structure
(vii) Hang-up	(G) Buffer storage to reduce processing delays
(viii) Inverted tree	(H) Output device
(ix) VA	(I) Problem in hardware, control software or media
(x) Spooling	(J) Term associated with magnetic tape

Answer 16. (a)

   (i) (C) Oracle

  (ii) (C) Star

 (iii) (A) Machine dependent

 (iv) (B) 1/1000th of a millionth of a second

  (v) (C) Method of data movement

 (vi) (A) HTML

 (vii) (B) Universal product code

(viii) (B) Disk Pack

 (ix) (A) Combination of BUS topologies

  (x) (D) Software in ROM

Answer 16. (b)

   (i) **ISAM** – Indexed Sequential File

  (ii) **SET** – Secure Electronic Transaction

 (iii) **MDR**-Monochrome Display Adapter

 (iv) **RADIUS** – Remote Authentication Dial In User Service

  (v) **APRANET** – Advanced Research Project Agency Network

 (vi) **RISC** – Reduced Instruction Set Computing

 (vii) **VRML** – Virtual Reality Modeling Language

(viii) **HTTP** – Hyper Text Transfer Protocol

 (ix) **WYSIWYG** – What You See Is What You Get

  (x) **WAIS** – Wide Area Information Service

Answer 1. (c)

  (i) — (D)

 (ii) — (A)

(iii) — (H)

 (iv) — (B)

  (v) — (J)

 (vi) — (E)

(vii) — (I)

(viii) — (F)

 (ix) — (C)

  (x) — (G)

Q. 17. As a Cost Accountant to M/s ABC, you have been asked to advise about the costs those various proposals relating to acquisition/installation, development and implementation of system & training etc. would entail.

You are required to :

(a) produce a layout of the headings which would be used to provide an estimate of the cost and the savings over a number of years of the proposal to purchase the hardware and the software.

(b) comment on the feasibility of using spreadsheet package for the data listed in part(a) above.

Answer 17. (a)

Cost and savings for M/s ABC are likely to include :

  (i) *Initial costs :*

    Capital Costs :

    (A) Hardware purchase costs

    (B) Installation costs

        Total costs

    Revenue Costs:

    (C) System development costs including consulting and software development fees and salaries (wages of staff involved in designing and implementing the system)

    (D) Redundancy payments, if any

    (E) Staff recruitment fees

    (F) Initial staff training

        Total initial revenue costs

        Total initial costs

 (ii) *Regular annual revenue costs :*

    (G) Staff salaries/wages

    (H) Consumable materials (disk, stationary, etc)

    (I) Power

    (J) Hardware maintenance costs

    (K) Software system support

    (L) Standby arrangements

    (M) Regular staff training

    (N) Variable overheads.

        Total regular costs

    Regular costs discounted at a company's cost of capital over the estimated life of the system.

    Total discounted costs (total initial costs and total discounted regular costs.)

(iii) *Savings :*

    (A) Saving in staff costs.

    (B) Other operating savings, e.g consumable materials.

    (C) Increased revenue due to more efficient system.

        Total annual savings.

    Annual savings discounted at a company's cost of capital over the estimated life of the system.

    Net present value of the proposed system (total discounted savings minus total discounted costs)

Answer 17. (b)

A spreadsheet package would provide a very suitable medium for analyzing the data discussed in part (a).

Spreadsheet package tends to be very user friendly and, assuming that the person doing the analysis has some familiarity with the particular package, it would be relatively simple matter to format a table and to provide the total costs and savings of the system. Text, values and formulae can be stored in different cells of the spreadsheet. Different formats are possible, it is likely that the first column would consist of row heading, with the second column containing the estimated costs under the various subheadings. Subsequent columns might be used for subtotals and totals.

The values of a modeling package such as spreadsheet lies specially in the ease with which the data can be manipulated in order to answer "what if" questions. For e.g the cost of certain items, the estimated life of the system, or the discount rate could each be varied either individually or simultaneously to quickly identify the effects on the total costs and savings. Various arithmetic and financial functions etc. can be used in operations.

Q. 18. (a) Which are the five pillars upon which a computer based information system rests?

      (b) Distinguish between top-down and bottom-up approach to system development.

Answer 18. (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).

Answer 18. (b)

Top-down approach	Bottom-up approach
The top down approach assumes a high degree of top management involvement in the planning process and focuses on organisational goals, objectives and strategies. Using the top-down approach, we begin by analysing organisational objectives and goals and end by specifying application programs and modules that need to be developed to support those goals. The various stages in top down approach are as follows : (i) Analyse the objectives and goals of the organisation to determine where it is going and what management wants to accomplish. The analysis may be started in terms of profits, growth, expansion of product line or services, diversification, increased market share and so on. It is also determined what resources are available in terms of capital, equipment and raw material.	The bottom up approach to system planning begins by identifying basic transactions and information processing programs. The development starts from the fundamental or lifestream systems of the personnel processing systems that support day-to-day business activities. As these systems are identified, the data and file requirements for each one can also be specified. Once the basic transactions and information processing systems are known, data requirements across applications are examined and the files and records combined in order to be usable for several applications. Thus, applications are integrated using data base concepts which enhances the sharability and evolvability of the data base, ensures that uniform data are used by all programs, and reduces the redundancy found so frequently in non-integrated, program-oriented files.

(ii) Identify the functions of the organisation (for example, marketing, production, research and development) and explain how they support the entire organisation.	Program, system and data integration are followed by the formulation of models to support higher management level activities. Decisions are then made using the output of the model-based analysis that have been integrated into the computer information systems.
(iii) Based on the functions identified above, ascertain the major activities, decisions and functions of the managers at various levels of hierarchy.	As more and more models are developed and used, model banks are established. A model bank is similar to a data base in that different planning and control models are developed and stored. They can be used to examine many different strategies.
(iv) With activities and decisions identified, we must now identify models that guide managerial decision processes and find out the information requirements for activities and decisions.	Thus, the bottom-up approach takes us to higher levels of decision making in the organisation. As we come closer to the strategic planning level, we need to integrate more and more data and information processing activities.
(v) Prepare specific information processing programs in detail and modules within these programs. We may also identify files and data base for applications.	

Q. 19. (a) What are four generations of micro computers? What is a super micro computer?

(b) What is an operating system? What are its basic functions?

(c) What is meant by "user friendly" software? What is a "menu" in a software?

Answer 19. (a)

The four micro-computer generations are distinguished in terms of the word size of the main processing unit e.g. 4 bit, 8 bit , 16 bit and 32 bit. The first generation of micro computers were programmable calculators which used 4 bit chip, a ROM for program memory and a RAM for data memory. The second generation featured 8 bit chips and led to introduction of personal computers such as those produced by Apple, Radio Shack and Commodore in 70's.

The third generation of micro computers are those computers with 16 bit chips. These were the first powerful personal computers leading to their proliferation that are visible all around.

The fourth generation of micro computers are those with 32 bit chips with ability to handle large memory and external disk storage. They also can handle multiple input and output devices. These are also known as super micros.

An important characteristic of super micros is use of multiple processors to relieve the CPU of the need to handle transfer of data to and from main memory, to move data to and from input and output units, and to perform special complex calculations.

Answer 19. (b)

An operating system is an integrated set of specialized programs that are used to manage the overall resources of and operations of the computer. It is specialized software that controls and monitors the execution of all other programs that reside in the computer, including application programs and other system software.

Major functions of an operating system are as follows :

(i)   *Job management* – The function includes scheduling of job, activation/deactivation of processes involved in the job.

(ii) *Memory management* – This involves allocation of main memory space to different jobs and keeping track of it.

(iii) *Device management* – It involves tracking the status of devices, allocation of various devices to jobs, activate them when needed.

(iv) *File management* – It involves efficient allocation of separate space for each file, arrangement of protection from loss of data etc.

(v) *Interaction with operators* – Interpretation of commands from operators, display of error/ interruption message.

(vi) *Security* – Function of protecting unauthorized access to system. For this purpose, security mechanism through password is followed.

(vii) *Job accounting* – Keeping track of time and resources used by different jobs etc.

Answer 19. (c)

User-friendly software-More and more people who are not computer professionals and not familiar with computer jargons use computers these days. To enable the to use computers, applications are written in such a way that the interface between the user and the application is easy to use.The ease of use of an application is known as "user friendliness".

A menu is a technique for enhancing user- friendliness of software. It provides the user with options to choose from just like a menu in a restaurant provides the customers a choice of items. An example of menu is as follows :

New

Open

Save

Save as

Print

Prepare

Send

Publish

Exit.

Q. 20. (a) Explanin briefly the stages through which the program has to pass during its development.

(b) Brief describe any five program design tools.

Answer 20. (a)

The system developer must instruct the computer how to do everything without error and in the required sequence. Hence, the development of application software has to go through a life cycle having following stages :

(i) **Program Analysis :** In this stage, for a particular application, the programmer ascertains the inputs available, the output required and to achieve that, what kind of processing is needed. Depending upon the complexity, the programmer then determines whether the proposed application can be or should be programmed at all. It is not unlikely that the proposal is shelved for modification on technical grounds.

(ii) **Program Design :** Depending upon the main function to be performed, the programmer develops the general organisation of the program. The input, output, file layouts, flowcharts, and program specification etc are provided to the programmer by the analyst.

(iii) **Program Coding :** The logic of the program expressed in the flowchart is converted into program instructions. While coding, the syntax of the language used is to be kept in mind.

The coded instructions are then entered into the magnetic media through available sources such as key to diskette. The program is then compiled through compiler of the language. Several syntax errors may crop up at this stage. These errors are required to be removed after getting the printed listing etc.

(iv) **Debug the program :** The meaning of debugging is to remove the errors so that the program may compile without errors. Many a times, structured walk through is to be adopted to remove the errors.

After debugging, the program is executed against test data. Several tests are performed and later the codes are reviewed to see whether these adhere to standards or not.

(v) **Program Documentation :** The writing of narrative procedures and instructions for people who will use software is carried out throughout the program life cycle. Managers and users should carefully review documentation to ensure that the software and system behave as the documentation indicates. If they do not, documentation should be revised. Following technical design specifications are generally included.

1. A brief narrative description of what the program should do.
2. A description of the output, inputs and processing to be performed by the program.
3. A deadline for finishing the program.
4. The identity of the programming languages to use along with coding standards to follow.
5. A description of the system environment into which the program should fit.
6. A description of the testing required to certify the program for use.
7. A description of documentation that must be generated for users, maintenance programmers and operational personnel.

The programmer writes the coding in the light of above documentation.

(vi) **Program Maintenance :** The requirements of business applications keep on changing and thus call for modification of various programs. The maintenance of the programs is generally done by people called maintenance programmers. The task of understanding the program written by some one and modifying the same is difficult. Therefore, the maintenance people should be involved from the beginning itself.

Answer 20. (b)

Five program design tools are briefly discussed below :

1. **Program flow chart :** Program flow chart is among the most common program design tools that managers and users encounter when reviewing the design work of the system development project. These flow charts depict the logical steps through which a computer program must proceed when solving a problem. At one time, program flow charts were considered the premier program design tool. Although they are still widely used, sometimes it is difficult for programmers to translate a program flow chart directly into a structured code.

   A program flow chart depicts the logical processing steps followed by a program quite well. However, unlike some of the other program design tools, they often do not provide a broad view of how the program is organised. However, they are useful for problems involving mathematical or scientific formulae.

2. **Pseudo code :** When reviewing the work done by a program designer, users may also need to review narrative descriptions of a program logic. Pseudocode, like program flow charts, also represents program logic. However, instead of using graphical symbols and flow lines, pseudo code presents program logic in English - like statements. Pseudocode is generally preferred by programmers over flowcharts because it represents program code more closely. Many users also find pseudo code more understandable than program flow charts.

Pseudo code is used in a variety of ways. For example many fourth - generation languages use pseudo code - like statements. Besides using pseudo code to design program code in a 3GL, it can be embedded into a completed 3GL program as non-executable 'comment' statements that serve as a documentation to indicate what the program is doing. Pseudo code is particularly useful when designing transaction processing and information- retrieval programs.

3. **Structure chart :** Another type of program design tool that a user may review is the program structure chart. Structure charts, which look similar to corporate organisation charts, are useful for organising problems. The structure chart organises each of the program tasks into well-defined modules. The higher-level modules represent control portions of the program; the lowest level modules do the actual task of the program. Unlike either flow charts or pseudo code, the structure chart does not give any detail of the actual program logic and the order in which various tasks are executed. Instead they show how all the logical functions of the program fit together as a whole.

4. **4GL Tools :** The various tools described above were developed as manually applied methods for designing programs or systems. The main drawback of manually applied tools is that they take a lot of time to prepare. Also, when a program flow chart is prepared or a structure chart is drawn, the programmer is not sure if it is internally consistent. Fourth-generation languages provide a way out to remove these obstacles by automating many of these manual tasks by using 4GL tools. These tools ensure that the work done with them is consistent with the other work performed by the system team. The automation of manual task and internal consistency checks are two reasons due to which productivity gains result from using 4GL tools.

5. **Object oriented programming and design tools :** These tools provide a means of enhancing programmer productivity and of reducing the application backlogs common in many organisations. Object oriented software design results in a model that describes object, classes and their relationships to one another. The object-oriented design is often taken from a data flow diagram (DFD). In fact, every input and output screen, every process and data store found in a fully decomposed DFD may be a candidate for an object in an object-oriented design. There is a wide variety of object oriented development tool kits available in the market.

By adopting 4GL and object-oriented programming tools, the organisations can decrease their application development time substantially.

Q. 21. (a) What do you understand by "Requirement analysis"? What is the significance of analysing the present system and how is it carried out?

(b) What are the different methods of system change over? Devise a checklist of activities that you would under take for moving from manual to computer based system?

Answer 21. (a)

Requirement analysis: This is the second stage of system development life cycle (SDLC). This analysis involves determining users' needs, studying the present system of the organisation in depth, and determining the features, which the new system should possess. Various fact-finding techniques and system development tools are used for requirement analysis.

During the requirement analysis phase of the traditional approach, the focus is one determining user needs, studying the application area in depth, assessing the strengths and weaknesses of the present system and reporting results to management.

The significance of studying in the present system is to know why the organization is not satisfied by this system. What are its strong and weak points? How the present system uses hardware, software and human resources to convert the data of the organization into information for end users. In addition, the system analysts should analyze how these resources are used to accomplish the activities of input, processing, output, storage and control.

Detailed investigation of the present system involves collecting, organising and evaluating facts about the system and the environment in which it operates. The survey of existing methods, procedures, data flow diagrams, outputs, files, input and internal controls should be done indepth in order to fully understand the present system and its related problems. While analysing the present system, the following areas should be studied in depth.

1. Review of historical aspects
2. Analysis of inputs
3. Review of data files maintained
4. Review of methods, procedures and data communication
5. Analysis of output
6. Review of internal controls
7. Model of existing physical & logical systems.

In order to determine the user needs and to find weaknesses and strong points about the present system, analysts use various fact finding techniques.

The fact finding techniques used by the Analyst for requirement analysis are as follows :

1. **Documents :** Manuals, input forms, output forms, diagrams of how the current system works, organization charts showing hierarchy of users and managers responsibilities, job description for the people who work with current system, procedure manuals, program codes for applications associated with current system etc. should be looked into as thoroughly as possible, since they are the rich source of information.

2. **Questionnaires :** Users and managers are asked to complete questionnaire about the information system when the traditional system development approach is chosen. Using questionnaires, a large amount of data can be collected through a variety of users quickly.

3. **Interviews :** Users and managers may also be interviewed to extract information from them. The information so obtained provides complete picture of the present system. The interview also gives analyst the opportunity to know about the first hand user reactions and to probe for further information.

4. **Observation :** In prototype approach, observation plays a central role in requirement analysis. The analyst visits the user place to watch how the work is taking place. While the user is experimenting with the prototype, the systems analyst observes the user and puts these observations into perspective in order to determine how the prototype should be further designed. This gives him first hand information rather than relying on other methods such as analysing documents, questionnaires etc.

Answer 21. (b)

System Changeover : The analyst must ensure that there' are suitable procedures laid down for the changeover from the old to the new computer based system as the implementation stage in the life cycle ofa system. There are various choices that can be made i.e (i) Direct changeover; (ii) Parallel running; (iii) Phased changeover.

Direct changeover : This type of changeover either for the very confident system designer or for a system that has been tried out and tested elsewhere. The hazards encountered with direct changeover are threefold —

(a) a flaw of the new system may not become apparent until the system is running;
(b) no results are available from the old system to validate the new system.
(c) errors are difficult to correct when the system is newly operational.

Parallel Running : Parallel running is the method adopted when the old and new systems are running together for an initial period. The results of the new system are validated by the results of the old. This method is possibly the safest way of bringing about the changeover from the old system to the new. However, there is considerable duplication of effort.

Pilot running : The difference between parallel running and pilot running is that the former used live data while the latter runs source data from a previous period. The pilot running is implementing the system on part of the data for validating its logic and controls.

Check-list of Activities : The following checklist of activities to be undertaken during the changeover phase of moving from a manual to a computer-based system :

(A) File conversion :

   (a) The objectives of the conversion can be stated to be as follows :

     (i) to ensure that all data is transferred efficiently from the old file to the new file in a complete error-free form which is compatible with system requirements;

     (ii) to ensure that the new file can be used in the system as a reliable source of standing and reference data.

   (b) The following problems may be encountered in the process of file conversion :

     (i) Arranging the data in a format required by the system, ensuring that the source data is complete and correct when it is captured.

     (ii) Arranging for the old file to be rationalised; a common problem encountered is multiplicity of accounts for the same supplier or customer.

     (iii) Arranging for the totals and balances from the old file to be carried over correctly to the new file.

     (iv) Ensuring that the user can process the new file with live data in an error-free manner.

   (c) Factors involved in the planning of file conversion would be :

     (i) Determine dates as follows :

      If the file conversion is planned to occur in phases, the timing of each phase; the cut-off date of the old system; the date when the old system is discontinued after parallel running;

     (ii) design standard documentation for capturing the source data for the file conversion process;

     (iii) institute system of manual checking over the transcription/coding of the data;

     (iv) investigate and amend rejections;

     (v) print the file and audit with source records; and

     (vi) prove the accuracy of the file by running the old and new system teams in parallel for a definite period in order to validate the new system.

(B) Testing :

   — ensure hardware is properly installed and operational

   — ensure individual programs perform as expected and can cope with both valid and invalid data.

   — ensure that system works as a whole without incompatibility between applications or overload of system at peak times.

(C) Method of changeover :

   — select most appropriate method of changeover e.g. direct, parallel or pilot running.

   — establish timetable for changeover

   — train all user departments prior to going live.

Q. 22. (a) Discuss the several integrity controls that DBMS has to support.

   (b) Distinguish between logical record and physical record in relation to DBMS.

   (c) Write a short note on System maintenance.

Answer 22. (a)

Data Integrity Controls (i.e. controls on the possible value a field can assume) can be built into the physical structure of the fields. In order to have the correct database, DBMS needs to have certain controls on the data fields. Some of the security controls that DBMS imposes on data fields are as follows :

(i) **Data Type :** In the data field, the data type defines the type of data to be entered in the field. It may be numeric, character etc.

(ii) **Length of data field :** The length of data field defines the maximum number of characters or digits (depending upon the data type) to be entered in the data field. It may be 256, 65536 etc.

(iii) **Default value :** It is the value a field will assume unless a user enters an explicit value for an instance of that field. Assigning a default value to a field can reduce data entry time and entry of a value to that field can be skipped. Default value helps in reducing the probability of data entry errors for most common values.

(iv) **Range Control :** This limits the set of permissible values a field can assume. The range may be numeric lower to upper bound or a set of specific values. Range control must be used with caution since the limits of range may change with time. A combination of range control and coding led to Y2K problem, in which a field for the year was represented by only the numbers 00 to 99.

(v) **Null Value Control :** Null value is an empty value. Each primary key field must have an integrity control that prohibits a null value. Any other required field may also have a null value control placed on it depending upon the policy of the organization. For example, a university may prohibit adding a course to its database unless that course has a title as well as value to the primary key, course-ID. Many fields legitimately may have null values so this control is to be used only when truly required.

(vi) **Referential Integrity :** This control on a field is a form of range control in which the value of that field must exist as the value in some field in another row of same or different table. That is the range of legitimate values comes from the dynamic contents of a field in a data base table, not from some pre-specified set of values. Referential integrity guarantees that only some existing cross-referencing value is used, not that it is the correct one.

Answer 22. (b)

No.	Logical Record	Physical Record
1.	The record defined by user is called Logical Record.	Storage of Logical Record in the computer is called Physical Record.
2.	It is the collection of those fields which are accessed by a single primary key.	It is the collection of those fields which are stored in adjacent memory location.
3.	Logical records are linked together with the help of File pointers.	Physical records are linked together with the help of Address Pointers.
4.	It may consist of Fixed length fields and Variable length fields.	All fixed length fields of Logical record are stored in one Physical record and each variable length field of Logical record is considered as separate physical record.

5.	Field Names, their data type and width are defined by user according to the requirements.	Physical record size is defined by Database Administrator (DBA) in such a way that it results in faster accessing of data.
6.	User is concerned with Logical record for insertion, deletion and updation of data.	Computer performs the required manipulation in the physical record.
7.	Sequence of fields in Logical record may be according to the convenience of user.	Sequence of fields in Physical record may not be same as Logical record.

Answer 22. (c)

System maintenance involves adding new data elements, modifying reports, adding new reports, changing calculations etc. to update systems. There are two categories of maintenance –

  (i) Scheduled i.e. anticipated and planned maintenance.

 (ii) Rescue maintenance for previously undetected malfunctions that were not anticipated but require immediate solution.

As systems increase and expand, systems maintenance places increasing demands on programmers' time. As information systems may remain in an operational and maintenance mode for several years, the system should be evaluated periodically to ensure that it is operating properly, changes may be incorporated to suit the changing needs of the users.

Q. 23. (a) Give one or two reasons for each of the following :

       (i) Use of multiplexer in data communication.

      (ii) Need of hub in a network.

     (iii) Use of Bridges in the Network.

     (iv) Need of Protocol Converters.

     (b) Describe the various factors which have contributed to the growth of Local Area Network (LAN).

Answer 23. (a)

  (i) **Multiplexer —** Multiplexer enables several devices to share one communication line. It scans each device to collect and transmit data on a single line to the CPU.

 (ii) **Need of hub in a network —** A hub is a hardware device that provides a common wiring point in a LAN. Each node is connected to the hub by means of simple twisted pair wires. The hub then provides a connection over a higher speed link to other LANs, the company's WAN or the Internet.

(iii) **Use of Bridges in the Network —** The main task of a bridge computer is to receive and pass data from one LAN to another. In order to transmit this data successfully, the bridge magnifies the data transmission signals. It can act as a repeater as well as a link.

(iv) **Need of Protocol Converters —** Protocols are the standard set of rules which govern the flow of data on a communication network. To enable diverse system components to communicate with one another and to operate as functional unit, protocol conversion is needed. It can be accomplished via hardware, software, or a combination of hardware and software.

Answer 23. (b)

The following factors contributed to the growth of Local Area Network (LAN) :

  (i) **Security :** Security for programs and data can be achieved using servers that are locked through both software and by physical means. Diskless nodes also offer security by not allowing users to download important data on floppies or upload unwanted software or virus.

(ii) Expanded PC usage through inexpensive workstation : Once a LAN has been set up, it actually costs less to automate additional employees through diskless PCs. Existing PCs can be easily converted into nodes by adding network interface cards.

(iii) Distributed processing : Many companies operate as if they had distributed system in place. If numerous PCs are installed around the office, these machines represent the basic platform for a LAN with inter-user communication and information exchange.

(iv) Electronic mail and Message Broadcasting : Electronic mail allows users to communicate more easily among themselves. Each user can be assigned a mail-box on the server. Messages to other users can then be dropped into the mail-box and read by them when they log into the network.

(v) Organizational Benefits : Benefits of LANs are numerous. These include reduced costs in computer hardware, software and peripherals, and a drastic reduction in the time and cost of training or re-training manpower to use the systems. In addition, the fact that you are networked helps managers and executive to communicate with each other more easily and faster, without any logistical constraints. Information flow too becomes a lot smoother with various departments having the ability to access or request for information and data pertinent to them.

(vi) Data management benefits : Since data is located centrally on the server, it becomes much easier to manage it, as well as back it up. No file is transferred between users through floppies.

(vii) Software cost and upgradation : If the organization is concerned about using licensed software, purchasing a network version can save a lot of money, since there would be no need to buy multiple copies of the same software for every machine in the organization. Therefore, software upgrades are much easier as any given package is stored centrally on the server.

Q. 24. (a) "Decision support systems are widely used as part of an Organisation's Accounting Information system". Comment.

(b) Define personnel information system. List its various basic sub-systems and explain them briefly.

Answer 24. (a)

Decision Support Systems are widely used as part of an organisation's AIS. The complexity and nature of decision support systems vary from organization to organization. Many are developed in-house using either a general type of decision support program or a spreadsheet program to solve specific problems. Some examples of DSS in Accounting includes :

- **Cost Accounting System :** The health care industry is well-known for its cost complexity. Managing cost in this industry requires controlling costs of supplies, expensive machinery, technology, and a variety of personnel. Cost Accounting applications help health care organisations calculate product costs for individual procedures or services. Decision support systems can accumulate these product costs to calculate total costs per patient. Combining cost accounting DSS and Productivity system applications allows managers to measure the effectiveness of specific operating processes to improve its management decision-making.

- **Capital Budgeting System :** Companies require new tools to evaluate high-technology investment decisions. Decision makers need to supplement analytical techniques with decision support tools that consider some benefits of new technology. One decision support system designed to support decisions about investments in automated manufacturing technology that is AutoMan, which allows decision makers to consider financial, non-financial, quantitative, and qualitative factors in their decision-making processes. Using this decision support system, accountants, managers, and engineers identify and prioritize these factors. They can then evaluate up to seven investment alternatives at once.

- **Budget Variance Analysis System :** Financial institutions rely heavily on their budgeting systems for controlling costs and evaluating managerial performance. DSS allows comptrollers to graph, view,

analyse, and annotate budget variances, as well as create additional one-and five year budget projections using the forecasting tools provided in the system. The decision support system thus helps the comptrollers create and control budgets for the cost-center managers reporting to them.

- **General Decision Support System :** These types of decision support systems are a decision-maker's tools that are used to input the data and answer questions about a specific problem domain to make use of this type of decision support system. An example is a program called Expert Choice. This program supports a variety of problems requiring decisions. The user works interactively with the computer to develop a hierarchical model of the decision problem. The decision support system them asks the users to compare decision variables with each other. Expert Choice analyses investment judgments and presents the decision maker with the best alternative.

Answer 24. (b)

The personnel information system deals with the flow of information about people working in the organization as well as future personnel needs. In most of the organizations, 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 computerized 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 union 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.

Q. 25. (a) Describe the main pre-requisites of a Management Information System, which makes it an effective tool.

(b) Explain the major constraints in operating a MIS.

Answer 25. (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.

Answer 25. (b)

Major constraints which come in the way of operating a MIS are :

(i) Non-availability of experts, who can diagnose the objectives of the organization and provide a desired direction for installing an operating system.

(ii) Experts usually face the problem of selecting the sub-system of MIS to be installed and operated upon.

(iii) Due to varied objectives of business concerns, the approach adopted by experts for designing and implementing MIS is a non-standardised one.

(iv) Non-availability of cooperation from staff in fact is a crucial problem. It should be handled tactfully. Educating the staff by organizing lectures, showing films, training on system and utility of the system may solve this problem.

(v) There is high turnover of experts in MIS. Turnover in fact arises due to several factors like pay packet, promotion chances, future prospects, behaviour of top ranking managers etc.

(vi) Difficulty in quantifying the benefits of MIS, so that it is easily comparable with cost.

Q. 26. (a) Discuss the functions and facilities provided by Treasury Cash Management module of an ERP package.

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

Answer 26. (a)

Treasury Cash Management component allows the analysis of financial transactions for a given period. It identifies and records future developments for the purpose of financial budgeting.

In Treasury Cash Management, the company's payment transactions are grouped into cash holdings, cash inflows and cash outflows. Cash Management module provides :

(i) Information on the sources and uses of funds to secure liquidity to meet payment obligations when they become due.

(ii) Monitors and controls incoming and outgoing payments flows.

(iii) Supplies data required for managing short term market investment and borrowings.

(iv) Enables to know current cash position, short term cash management and medium and long term financial budgeting.

(v) Enables analysis of liquidity.

(vi) Helps in cash management decisions.

(vii) In bank accounting, it helps in electronic banking and control functions for managing and monitoring of bank accounts.

(viii) The liquidity forecast function integrates anticipated payment flows from financial accounting, purchasing and sales to create liquidity outlook from medium to long term.

(ix) Covers foreign currency holdings and foreign currency items.

Answer 26. (b)

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.

Q. 27. (a) Write short note on source program library control.

(b) Why is Computer fraud a serious threat to any business organisation?

Answer 27. (a)

In large computer systems, application program modules are stored in source code form on magnetic disks called the source program library (SPL).

To control the SPL, protective features and procedures must be explicitly addressed. This requires the implementation of SPL management system. This software is used to control four critical functions.

- Storing programs on the SPL.
- Retrieving program for maintenance purposes.
- Deleting obsolete programs from the library.
- Documenting program changes to provide an audit trail of the changes.

SPLMs may be supplied by the computer manufacturer as part of operating system or may be purchased through software vendors. An SPL requires specific planning and control techniques to ensure program integrity. The following control techniques may be used :

- **Password control :** One form of access control over the SPL is provided by assigning passwords. Every financially significant program stored in the SPL can be assigned a separate password. However, passwords have drawbacks. When more than one person is authorized to access a program, preserving the secrecy of a shared password is a problem.
- **Separation of Test Libraries :** Under this concept, a strict separation is maintained between the production programs that are subject to maintenance in the SPL and those being developed. Production programs are copied into the programmer's library for maintenance and testing purposes only. Direct access to the production SPL is limited to a specific librarian group that must approve all requests to modify, delete, and copy programs. Passwords for production programs can be changed regularly and disclosed only on a need-to-know basis.

Answer 27. (b)

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. :
  - A few keystrokes are needed to manipulate the invisible data.
  - Employees as well as outsiders can access any computer remotely.
  - 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.

Q. 28. (a) What are the constituents of a Data Centre? Describe the various services provided by it.

(b) Explain any five features offered by e-mail software.

Answer 28. (a)

Constituents of a Data Centre : 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.

Some of the value added services that data centres provide are :

(i) **Database Monitoring :** This is done via a database agent, which enables the high availability of the database through comprehensive automated management.

(ii) **Web Monitoring :** Access and monitor website performance, availability, response and integrity from a visitor's perspective.

Report on HTTP, FTP service status, monitor URL availability, verify web content accuracy and changes.

(iii) **Backup and restore :** Provide centralized multi-system management capabilities

Provide comprehensive integral management solution to data storage using backup agent for the operating systems, database and applications.

(iv) **Intrusion detection :** Detect malicious activity on the host – based ID systems and, network-based ID systems,

Provide automated network security assessment and policy compliance evaluation.

(v) **Storage on demand :** Provide back-end infrastructure as well as expertise, best practices and process to give a robust and cost-effective storage strategy. Data storage infrastructure provide security, reliability and availability of data to meet company demands.

Answer 28. (b)

Electronic mail (e-mail) on the Internet provides quick and cost effective transfer of messages to other e-mail users worldwide. The e-mail software comprises of many important and useful features. Five of them are briefly discussed below :

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

(ii) **Replying to the 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, typing the subject matter etc.

(iii) **Address book :** This is an electronic form of address book wherein the following information can be saved: Name, full address, e-mail address, organization and designation of a person etc. It is also possible to store addresses on the basis of categories. Letters or circulars can be sent to individual address or all members of a particular category.

(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 the user is offline, he should read all the messages that have been received. Even composing of messages can be done offline. This saves Internet time as well as helps in keeping the telephone line free.

In addition to above mentioned features, e-mail software also allows forwarding of messages, transfer of data files and sending e-greeting cards on various occasions.

Q. 29. (a) Describe the major techniques of Concurrent Audit of Information systems. What is the relevance of such Audit?

(b) Discuss various factors that render manual audit method ineffective in IS audit.

Answer 29. (a)

Commonly used concurrent audit techniques for information systems are discussed below :

(i) An Integrated Test Facility Technique (ITF) places a small set of fictitious records in the master files. Processing test transactions to update these dummy records will not affect the actual records. Since fictitious and actual records are processed together, company employees usually remain unaware that this testing is taking place. The system must distinguish ITF records from actual records, collect information on the effects of the test transactions and report the results. The auditor compares processing and expected results in order to verify that the system and its controls are operating correctly.

In a batch processing system, the ITF technique eliminates the need to reverse test transactions and is easily concealed from operating employees. ITF is well suited to testing on-line processing systems because test transactions can be submitted on a frequent basis, processed with actual transactions, and traced throughout every processing stage. All this can be accomplished without disrupting regular processing operations. However, care must be taken not to combine dummy and actual records during the reporting process.

(ii) The Snapshot Technique examines the way transactions are processed. Selected transactions are marked with a special code that triggers the snapshot process. Audit modules in the program record these transactions and their master file records before and after processing. Snapshot data are recorded in a special file and reviewed by the auditor to verify that all processing steps have been properly executed.

(iii) System Control Audit Review File (SCARF) uses embedded audit modules to continuously monitor transaction activity and collect data on transactions with special audit significance. The data are recorded in a SCARF file. Transactions that are generally recorded in a SCARF file include those exceeding a specified limit, inactive accounts, deviating from company policy, or containing write-downs of asset values etc. Periodically the auditor examines the SCARF file to identify questionable transactions and performs the necessary follow- up investigations.

(iv) Audit hooks are audit routines that flag suspicious transactions. For example, internal auditors at Insurance Company determined that their policyholder system was vulnerable to fraud every time a policyholder changed his or her name or address and then subsequently withdrew funds from the policy. They devised a system of audit hooks to tag records with a name or address change. The internal audit department will investigate these tagged records for fraud. When audit hooks are employed, auditors can be informed of questionable transactions as soon as they occur. This approach of real-time notification displays a message on the auditor's terminal.

(v) Continuous and Intermittent Simulation (CIS) module that is embedded in a data base management system, examines all transactions that update the DBMS using criteria similar to SCARF. If a transaction has special audit significance, the module independently processes the data, records the results and compares them with those obtained by DBMS. If any discrepancies exist, the details are written on to an audit log for subsequent investigation. In case of serious discrepancies, CIS may prevent the DBMS from executing the update process.

Relevance of Concurrent Audit Techniques for Information System :

Millions of rupees worth of transactions can be processed in an on-line system without leaving a satisfactory audit trail. Evidence gathered after data processing is insufficient for audit purposes. Since many on-line systems process transactions continuously, it is difficult or impossible to stop the system in order to perform audit tests. When it is needed to continually monitor the system and collect audit evidence while live data are processed during regular operating hours, concurrent audit techniques are used. These techniques perform audit functions, they also report test results to the auditor and store the evidence collected for the auditor's review.

Answer 29. (b)

The audit methods that are effective for manual audits prove ineffective in many IS audits because of the following factors :

(i) **Electronic evidence :** Essential evidence is not physically retrievable by most auditors, and it is not readable in its original electronic form.

(ii) **Terminology :** The tools and techniques used in automated applications are described in terms that are difficult for the non-EDP auditor to understand.

(iii) **Automated processes :** The methods of processing are automated rather than manual, making it difficult for the non-EDP auditor to comprehend processing concepts and the logic of these concepts.

(iv) **New risks and controls :** Threats to computer systems and the countermeasures to those threats are new to non-EDP auditors, and the magnitude of the risks and the effectiveness of the controls are not understood.

(v) **Reliance on controls :** In manual systems, the auditor can place some reliance on hard-copy evidence regardless of the adequacy of the controls. Whereas, in automated systems, the electronic evidence is only as valid as the adequacy of controls.

Q. 30. (a) Define the following terms with reference to Section 2 of Information Technology Act, 2000 :

    (i) **Key Pair**

    (ii) **Originator**

    (iii) **Secure System**

  (b) Explain the duties of certifying authority in respect of digital signature.

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

Answer 30. (a)

(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) **Originator :** It refers to a person who sends, generates, stores or transmits any electronic message or causes any electronic message to be sent, generated, stored or transmitted to any other person but does not include an intermediary.

(iii) **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.

Answer 30. (b)

Duties of Certifying Authority in respect of Digital Signature :

(i) Every certifying authority shall follow certain procedures in respect of digital signatures as given below :

- make use of hardware, software and procedures that are secure from intrusion and misuse,
- provide a reasonable level of reliability in its services which are reasonably suited to the performance of intended functions,
- adhere to security procedures to ensure that the secrecy and privacy of the digital signatures are assured and
- observe such other standards as may be specified by regulations.

(ii) Every certifying authority shall also ensure that every person employed by him complies with the provisions of the Act, or rules, regulations or orders made there under.

(iii) A certifying authority must display its license at a conspicuous place of the premises in which it carries on its business and a certifying authority whose license is suspended or revoked shall immediately surrender the license to the controller.

(iv) Every certifying authority shall disclose its digital signature certificate, which contains the public key corresponding to the private key used by that certifying authority and other relevant facts.

Answer 30. (c)

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.