PAPER 9 – Operation Management & Information Systems

SECTION I - OPERATION MANAGEMENT

1. (a) Fill in the blanks with appropriate words:

(i) Method Study should ---------- work measurement.
(ii) A slack variable represents ---------capacity.
(iii) ---------- consists of shared values, beliefs and norms of organization.
(iv) ---------- is the process of polishing a work, after grinding, by means of abrasive materials to give fine finish.
(v) Shift working is suitable in case of ---------- intensive technology.
(vi) Optimum Capacity is rate of output at which there is ---------- to change the size of the plant.
(vii) Final stage of production planning, where production activities are coordinated and projected on a time scale is known as ……
(viii) It is desirable to conduct work measurement after …….
(ix) In aggregate planning, one of the methods in modification of demand ……..
(x) Variety reduction is generally known as……..

(b) Indicate whether the following statements are True/False

(i) Industrial Engineering is a line function.
(ii) Free Float = Independent float - Head Event Slack.
(iii) Dummy Activities are used in Network Analysis.
(iv) Factor Comparison is a method of job evaluation.
(v) Forging is the process of pouring molten metal into prepared Cavity.
(vi) Annealing involves heating and cooling operations.
(vii) Labour card is prepared by dispatching department to book the labour involved in each operation.
(viii) Z Chart is used in Quality Control.
(ix) Total output of all sectors is equal to total input of all sectors.
(x) Flow control is applied in chemical industries.

Answer:

1. (a) (i) Precede
(ii) Unused
(iii) Culture
(iv) Lapping
(v) Capital
(vi) No incentive
(vii) Scheduling
(viii) Method Study
(ix) Differential Pricing
(xi) Simplification

(b) (i) False
(ii) False
(iii) True
(iv) True
(v) False
(vi) True

(vii) False
(viii) False
(ix) True
(x) True

2. (a) 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.

(b) State the name of the following processes:

(i) Heating metal into red and hammering into shape.
(ii) Heating and cooling operations.
(iii) Pouring molten metal into prepared cavity.
(iv) Fusing metals together while in molten state.
(v) Surface smoothing process with hand or machine
(vi) Cutting and removing material from surface of the workpiece.

(c) What do following abbreviations stand for:

(i) MTM - Method Time Measurement.
(ii) MBO - Management by Objectives.
(iii) FMS - Flexible Manufacturing System.
(iv) CRAFT- Computarised Relative Allocation of Facilities Techniques.
(v) IPPS- Integrated Production Planning System.
(vi) LOB- Line Of Balance.
(vii) AQL- Acceptable Quality Level
(viii) MTBF- Mean Time Between Failures.
(ix) BOLT- Built, Operate, Lease and Transfer.
(x) SCM- Supply Chain Management.

(d) State suitable Material Handling Equipments used in following operations:

(i) Iron scrap in a scrap yard
(ii) Red hot steel billets in a rolling mill
(iii) Charging iron ore in a blast furnace
(iv) Move palletised unit loads
(v) For movement of small components in a shop

Answer:

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

(b)
(i) Forging
(ii) Annealing
(iii) Casting
(iv) Welding

(v) Lapping
(vi) Turning

(c)
(i) MTM - Method Time Measurement.
(ii) MBO - Management by Objectives.
(iii) FMS - Flexible Manufacturing System.
(iv) CRAFT- Computarised Relative Allocation of Facilities Techniques.
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(d)
(i) Iron scrap in a scrap yard-**Lifting magnet and crane**
(ii) Red hot steel billets in a rolling mill – **Roller Conveyor**
(iii) Charging iron ore in a blast furnace-**Bucket Elevator**
(iv) Move palletised unit loads - **Fork-lift truck**
(v) For movement of small components in a shop –**Hand Trolley**

3. (a) What do you mean by "Plant Shut Down"? Under what situations will you advise to resort to plant shut down?
(b) What is Retraining?
(c) Discuss the points to be considered while designing a Maintenance programme for an organization?

Answer:

3. (a) 'Plant shutdown' means total stoppage of plant and production activities by cutting off in-coming power supply to the plant. Plant shutdown is resorted to under the following conditions :
(i) At the time of puja holidays for doing preventive and major overhauling jobs.
(ii) Due to unusual situations.
(iii) At the time of recession when demands fall considerably.
(iv) When prices are less than total cost.
(v) For minor repair of generators, transformers, etc., after the normal working hours.

(b) Retraining can be defined as a programme designed to avoid redundancy and obsolescence. All the individuals become outdated with the passage of time, in terms of job requirements. The main aim to retrain is to protect rank and file workers at its core.

Retraining can also be referred to as a 'refresher course 'to install a new technologies, skills, methods etc whenever such things are necessary consequent upon modernization, upgradation, diversification etc. Infact, it is a process of infusing fresh blood in the organization.

(c) While designing a maintenance programme the main objective of management should be to reduce the total cost of maintenance without sacrificing the efficiency and effectiveness of the plant. The following points are to be considered while designing a maintenance programme:

(i) The maintenance operation should increase the life of the asset at affordable cost.
(ii) The maintenance programme should not affect the normal working of the plant. This involves proper planning, having spare machines etc.
(iii) Manpower required for maintenance plan should determined and proper training should be imparted to them.
(iv) The equipments may be classified according to their criticality.
(v) Lubrication schedules should be prepared, spares and equipment replacement policy should be decided.
(vi) The maintenance plan should be communicated to all concerned.
(vii) Techniques to be employed in carrying out maintenance.
(viii) Maintenance standard time may be fixed.
(ix) The programme itself may have to be modified in light of the experience gained.

4. (a) What causes variations in Quality?
(b) Quality control in synonymous with inspection – comment.
(c) Describe the various stages of ensuring 'quality' of a product ?

Answer:

4. (a) Variation in quality occurs due to chance causes and assignable causes. Chance causes are inherent in the process .It is difficult and uneconomical to detect and eliminate them. They are random and independent of each other and are natural and permissible.
Assignable causes are due to improper raw material, bad working, or negligence on part of the worker. They are non random, identifiable, and controllable.

(b) This statement is not correct. Inspection only certifies whether a material or product conforms to a specified standard, i.e., whether it can be accepted as good material, or rejected. It cannot improve the quality of the material, or product.

Quality control, on the other hand, aims at improving the quality of the product form the design stage upto the after sales service to the customers. It locates the defects at all stages and takes appropriate corrective action to prevent manufacture of defective products.

(c) The various stages of ensuring 'quality' of a product are given below :
(i) **Design**: At the design stage the designer considers everything for ensuring quality and specifies the material specifications and quality attributes, e.g., fits and tolerances.
(ii) **Incoming Materials:** All materials received from vendors should be properly checked and tested by the inspection department before taking them into stock.
(iii) **Machines and Methods:** The machine installed and methods prescribed must be able to produce products of desired quality.
(iv) **Process Control:** It evaluates, maintains and improves quality standards of product at different stages of manufacture. It also identifies sub-quality products and stops further processing on it.
(v) **Performance Testing:** Before dispatching the products to consumers it is necessary to check its performance and conformance with the design specifications.
(vi) **After Sales Service:** The quality of the product is further improved by more effective and quick after sales services.

5. (a) Describe in brief the concept of FMS. What are its advantages and disadvantages?
(b) Write short notes on Forecasting.

Answer:

5. (a) A Flexible Manufacturing System is a hybrid between continuous and intermittent flow of production. Here, using computer controlled machine and automated material handling equipment, a continuous flow is instilled in otherwise high variety, low production volume flow. Thus FMS is builds on the programmable automation of NC and CNC machines. Programs and tooling set up can be quickly changed and production can be switched on from one job to another without any loss of change-over time.
Key components of FMS are:
(i) Several computer controlled workstations having CNC machines and robots for loading and unloading.
(ii) Computer controlled transport systems for moving materials and parts from one machine to another.
(iii) Computer controlled robots for loading and unloading stations.
(iv) An automated storing and retrieval system.

The above subsystems of FMS are controlled by a central computer with the needed software.

Advantages of FMS can be broadly divided into following:
(i) **Flexibility:** with slight changes in programs the system can be used with less recurring capital investment.
(ii) **Adaptability:** With little training the supervisors can take up family of jobs earmarked to the system.
(iii) **Wider scope:** Advanced manufacturing technology continuously opens newer application areas.
(iv) Lesser human effort results in less amount of human error.
(v) Improved productivity through better quality, effective control of a small area.

Disadvantages of FMS are as follows:
(i) High initial capital investment.
(ii) Limited ability to adopt to production changes.
(iii) Substantial preplanning, tooling and fixture requirements.
(iv) Standardisation of part design required to reduce the number of tools.
(v) Long planning required to install FMS.

(b) **Forecasting** - Forecasting means peeping into the future. As future is unknown and is anybody's guess but the business leaders in the past have evolved certain systematic and scientific methods to know the future by scientific analysis based on facts and possible consequences. Thus, this systematic method of probing the future is called forecasting. In this way forecasting of sales refers to an act of making prediction about future sales followed by a detailed analysis of facts related to future situations and forces which may affect the business as a whole.

Making of a proper forecast requires the assessment of both controllable and uncontrollable factors (both economic and non economic) inside and outside the organisation. The period of forecasting, that is the time range selected for forecasting depends on the purpose for which the forecast is made. The period may vary from one week to some years. Depending upon the period, the forecast can be termed as 'Short

range forecasting', medium range forecasting' and 'Long range forecasting'. 'Short range forecasting period may be one week, two weeks or a couple of months. Medium range forecasting period may vary from 3 to 6 months. Long range forecasting period may vary from one year to any period. The objective of above said forecast is naturally different. In general, short term forecasting will be of more useful in production planning. The manager who does short range forecast must see that they are very nearer to the accuracy. In long range forecast, the normal period used is generally 5 years. In some cases it may extends to 10 to 15 years also.

6. (a) State the importance of HRP to an organization.
(b) What are the principles to be borne in mind while designing a plant layout.

Answer:

6. (a) Human resource planning is important to organisation because it benefits the organisation in several ways.
The important ones are mentioned below:
1. By maintaining a balance between demand for and supply of human resources, human resource planning makes optimum use of human resources, on the one hand, and reduces labour cost substantially, on the other.
2. Careful consideration of likely future events, through human resource planning might lead to the discovery of better means for managing human resources. Thus, foreseeable pitfalls might be avoided.
3. Human resource planning compels management to assess critically the strength and weaknesses of its employees and personnel policies on continuous basis and, in turn, take corrective measures to improve the situation.
4. Human resource planning helps the organisation create and develop training and successions planning for employees and managers. Thus, it provides enough lead time for internal succession of employees to higher positions through promotions.
5. Human resource planning meets the organisation need for right type of people in right number at right times.
6. It also provides multiple gains to the employees by way of promotions, increase in emoluments and other perquisites and fringe benefits.
7. Last but no means the least, with increase in skill, knowledge, potentialities, productivity and job satisfaction, organisation becomes the main beneficiary. Organisation is benefited in terms of increase in prosperity /production, growth, development, profit and, thus, an edge over its competitors in the market.
8. Manpower shortfalls and surpluses may be avoided, to a large extent.
9. Some of the problems of managing change may be foreseen and their consequences mitigated. Consultations with affected groups and individuals can take place at an early stage in the change process. This may avoid resistance for change.
10. Through human resource planning, duplication of efforts and conflict among efforts can be avoided, on the one hand, and coordination of worker's efforts can be improved, on the other.

(b) Plant Layout- Principles:
The layout selected in conformity with layout principles should be an ideal one. These principles are:-

- **Principle of Minimum Travel:** Men and materials should travel the shortest distance between operations so as to avoid waste of labour and time and minimise the cost of materials handling.
- **Principle of Sequence:** Machinery and operations should be arranged in a sequential order. This principle is best achieved in product layout, and efforts should be made to have it adopted in the process layout.
- **Principle of Usage:** Every unit of available space should be effectively utilised. This principle should receive top consideration in towns and cities where, land is costly.
- **Principle of Compactness:** There should be a harmonious fusion of all the relevant factors so that the final layout looks well integrated and compact.
- **Principle of Safety and Satisfaction:** The layout should contain built in provisions for safety for the workmen. It should also be planned on the basis of the comfort and convenience of the workmen so that they feel satisfied.
- **Principle of Flexibility:** The layout should permit revisions with the least difficulty and at minimum cost.
- **Principle of Minimum Investment:** The layout should result in savings in fixed capital investment, not by avoiding installation of the necessary facilities but by an intensive, use of available facilities.

7. (a) What is Material Requirement Planning?
(b) What factors might cause a company to order an amount larger or smaller than Economic Order Quantity?

Answer:

7. (a) Material requirement planning (MRP) refers to the basic calculations used to determine component requirements from end item requirements. It also refers to a broader information system that uses the dependence relationship to plan and control manufacturing operations. MRP is a technique of working backward from the scheduled quantities and needs dates for end items specified in a master production schedule to determine the requirements for components needed to meet the master production schedule. The technique determines what components are needed, how many are needed, when they are needed and when they should be ordered so that they are likely to be available as needed. The MRP logic serves as the key component in an information system for planning and controlling production operations and purchasing. The information provided by MRP is highly useful in scheduling because it indicates the relative priorities of shop orders and purchase orders.

"Materials Requirement Planning (MRP) is a technique for determining the quantity and timing for the acquisition of dependent demand items needed to satisfy master production schedule requirements." MRP is one of the powerful tools that, when applied properly, helps the managers in achieving effective manufacturing control.

(b) It is always desirable to be strict to EOQ model. But it is to be kept in mind that EOQ model is useful under condition of certainty. Under real life situation, it is rarely so. Possible reasons for violation of EOQ model may be:
   (i) The demand pattern of inventory and lead time is not certain.
   (ii) Most of the firm maintains some amount of margin of safety or safety stock to cater to the contingent situation. These are based on own assumption. Hence actual quantity may vary from man to man.

(iii) The amount arrived at through EOQ computation may not be available or may not be accepted by the transporters.
(iv) Mismatch between transportation cost and EOQ associated cost.
(v) Panicky buying tendency of the person engaged.
(vi) Firm may be inclined to take advantage of impeding price hike by the suppliers and /or discount offered. Holding gain in inventory may also be important.

8. (a) How can an organization control pollution?
(b) Uses of Jigs and Fixtures.
(c) What are the four classes of Drilling machines?

Answer:

8. (a) Pollution cannot effectively be controlled by the use of a single technique. Since the causes and the effects of different types of pollution are diverse and distinct from each other, there cannot be any thumb- rule or golden rule which could be applied in the present context. However, in general, a prudent use of the techniques given below, in conjunction with other appropriate measures, is bound to bring in the desired results. These are:
1. Controlling at source.
2. Controlling during processes, operations and other activities.
3. Control by suitable enclosures.
4. Control by protection.
5. Control by preventions.
6. Control by absorption.
7. Adhering to regulations laid down by the following authorities:
(a) Respective state governments.
(b) Central Government.
(c) Guidelines issued by the global bodies representing individual pollution control measures.
(d) Ensuring compliance with any other law for the time being in force.

(b) Jig is a device designed for holding the job and grinding the path of tool for a particular operation on a number of similar operations. A fixture is used to hold and support the work piece in a predetermined position for a particular machining operation.

Uses of jigs and fixtures are as follows:
1) Jigs quickly and accurately guide the tools .Difficult operations are rendered easier, speedier, and yet more accurate by using jigs.
2) Jigs help in mass production by producing accurately machined interchangeable parts.
3) Fixtures are essential in all machine work, because work must be firmly held at the time of working of tools.
4) Fixtures used along with jigs increase the speed and accuracy of work.

(c) Drilling Machines may be broadly grouped into the following four classes, such as:
(i) Sensitive Drilling Machines
(ii) Pillar Drilling Machines
(iii) Radial Drilling Machines
(iv) Multiple Spindle Drilling Machines.

9. (a) What is Degeneracy in a simplex LPP? How is it resolved?
(b) What are the disadvantages of automation?
(c) What is 'Gantt Chart'? How is it used?

Answer:

9. (a) The concept of obtaining a degenerate basic feasible solution in a LPP is known as Degeneracy. The degeneracy in a LPP may arise
(i) At the initial stage when at least one basic variable is zero in the initial basic feasible solution.
(ii) At any subsequent iteration when more than one basic variable is eligible to leave the basic and hence one or more variables becoming zero in the next iteration and the problem is said to degenerate. There is no assurance that the value of the objective function will improve, since the new solutions may remain degenerate. As a result, it is possible to repeat the same sequence of simplex iterations endlessly without improving the solutions. This concept is known as cycling or circling.

Degeneracy is solved by the following procedure:
(i) Divide each element in the tied rows by the positive coefficients of the key column in that row.
(ii) Compare the resulting ratios, column by column, first in the identity and then in the body, from left to right.
(iii) The row which first contains the smallest algebraic ratio contains the leaving variable.

(b) Disadvantages of automation are:
(i) Heavy capital investment
(ii) Displacement of labour
(iii) Loss of suggestions from employees
(iv) Design specifications for raw materials cannot be relaxed
(v) Cost of shutdown of automated plant due to shortage of materials is quite high
(vi) Dehumanisation.

(c) The Gantt chart was probably the first technique to be applied to project planning and control. This chart is a simple way to show graphically both the anticipated and completed portions of a project. The horizontal axis of the chart represents time. Activities are scheduled by plotting them as bars on the chart, observing all precedence relationships. The percentage of each activity that is complete is indicated either by shading the appropriate portion of the bar or by placing a caret on the bar. By drawing a vertical line through the current data, one can determine whether the activities are ahead or behind schedule. The Gantt chart can be machine or project based. The machine based chart also includes a repair or maintenance activity, which is indicated by crossing out the time period in which the planned down time will occur.

Uses : There are various uses of such a technique :
(i) It forces a plan to be made.
(ii) Work planned and works accomplished are easily compared.
(iii) The chart is easy to produce and is dynamic in nature.
However, it fails to describe the dependency or interaction among various project tasks. Moreover, it is not readily adaptable as an analytical tool.

10. (a) Two alternative methods X and Y using different tooling set-ups may be employed to manufacture a component on a particular machine tool whose operating cost is ₹ 20 (including wages of operator) per hour.

Particulars	Method X	Method Y
Component	4000 pieces	3000 pieces
Cost of tooling	₹ 320	₹1500
Production rate per hour	10 pieces	15 pieces

Justify with suitable calculation which of the two methods would you choose as being more economical for regular production? Would your answer be different if only 1000 pieces of particular component are required?

(b) A firm is considering for alternative locations for a new plant. It has attempted to study all costs at the various locations and finds the production costs of the following items vary from one location to another. The firm will finance the new plant from deposits, fetching 10% interest.

Particulars	A	B	C	D
Labour (per unit) (₹)	7.50	11.00	8.00	9.00
Plant construction cost (₹ Crores)	4.6	3.9	4.0	4.8
Material & equipment (per unit) (₹)	4.30	6.00	4.00	5.50
Electricity (per yr.) (₹ Lakhs)	3.0	2.60	3.00	2.80
Water (per yr.) (₹ Lakhs)	0.7	0.6	0.7	0.7
Taxes (per year) (₹ Lakhs)	3.3	2.8	6.3	3.5
Transportation (Per unit) (₹)	0.20	1.00	1.00	0.50

The material and equipment includes a projected depreciation, but no interest. If the plant is designed to have an effective system capacity of 10,000 units per year and is expected to operate at 80% efficiency, what is the most economic location on the basis of actual output?

Answer:

10. (a) The unit cost of two methods are as follows:

	Method X	Method Y
Cost of tooling	₹ 320	₹1500
Hours required	4000/10 = 400	3000/15 = 200
Operating cost	400*20 = ₹8000	200*20 = ₹4000
Total production costs	Rs8320	5500
No. of pieces	4000	3000
Cost per piece	₹2.08	₹1.83

Therefore Method Y is more economical.

If only 1000 pieces are required the cost would be as follows:

	Method X	Method Y
Cost of tooling	₹320	₹1500
Hours required	1000/10 = 100	1000/15 = 66.67
Operating cost	100*20 = 2000	66.67*20 = 1333.4
Total cost of production	2320	2833.40
Cost per unit	₹2.32	2.83

In this case X is cheaper.

(b) Actual output = (System efficiency x System capacity)
= 0.80 x 10,000 = 8,000 units / year.

Particulars	A	B	C	D

Fixed cost/year (₹ In lakhs)				
10% of investment	46.00	39.00	40.00	48.00
Electricity	3.00	2.60	3.00	2.80
Water	0.70	0.60	0.70	0.70
Taxes	3.30	2.80	6.30	3.50
Total	53.00	45.00	50.00	55.00
Variable cost/unit (₹)				
Material and equipment	4.30	6.00	4.00	5.50
Labour	7.50	11.00	8.00	9.00
Transportation	0.20	1.00	1.00	0.50
Total	12.00	18.00	13.00	15.00

Cost per site = Fixed cost + Variable Cost
A = 53,00,000 + 8,000 x 12 = ₹ 53,96,000
B = 45,00,000 + 8,000 x 18 = ₹ 46,44,000
C = 50,00,000 + 8,000 x 13 = ₹ 51,04,000
D = 55,00,000 + 8,000 x 15 = ₹ 56,20,000

The most economic location is B.

11. (a) The breakdown probability of an equipment is given below :

Month	Probability
1	**0.05**
2	**0.15**
3	**0.30**
4	**0.30**
5	**0.20**

There are 50 equipments in the plant. The cost of individual preventive replacement is ₹ 15 per equipment and the cost of individual breakdown replacement is ₹ 30 per equipment. Find out the average break down maintenance cost per month.

(b) A workshop has 20 identical machines, whose failure pattern is as below :

Elapsed time in months :	**1**	**2**	**3**	**4**	**5**	**6**
No. of machines failed :	**4**	**3**	**3**	**3**	**3**	**4**

It costs ₹ 150 to attend to a breakdown machine. A maintenance contractor offers preventive maintenance of the machines and in return guarantees no failure of the machine for one year. He charges ₹ 450 per machine/ year.

Would you go for the preventive maintenance contract?

(c) A motor manufacturing company is considering the purchase of an automatic winding machine to replace an existing manual machine. The existing machine cost ₹ 1,20,000 two year ago and thus been depreciated down to ₹ 1,00,000 book value using a 12-year life and no salvage value. However, the market value of the machine is only ₹ 50,000 now.

The automatic machine would improve product quality enough to boost revenue from an existing ₹ 10,00,000 per year to ₹ 12,50,000 per year. It would cost ₹ 5,00,000 and will have a 10 year life. Any salvage value on it would be spent in removal expenses. A natural advantage of the automatic machine is that by reducing annual labour cost, it would cut operating expenses from ₹ 1,00,000 to ₹ 50,000 annually. The manufacturer pays a corporate tax of 50% and estimates the firm's cost of capital @ 12%. The discount factor PV of cash flows of 10 years @ 12% is 5.65.

Answer:

11. (a) Average mean life of the equipment
= 1 x 0.05 + 2x 0.15 + 3 x 0.30 + 4 x 0.30 + 5 x 0.20 = 3.45 months.

Therefore, average breakdown maintenance cost per month = (50/3.45)x ₹ 30 = ₹ 434.78.

(b) Mean months in service before failure
= (4/20) x 1 + (3/20) x 2 + (3/20) x 3 + (3/20) x 4 + (3/20) x 5 + (4/20) x 6
= 3.5 months.

Yearly cost of breakdown maintenance
= No. of machines failed/year x Costs for attending each breakdown machine
= 20 x (12/3.5) x 150
= ₹ 10,286

Cost of preventive maintenance = ₹ 20 x 450 = ₹ 9,000 per year.

Since, ₹ 9,000 < ₹ 10,286, one should go for the preventive maintenance contract.

(c) The cash flows on the existing and new machines are given below :

	Existing machine		New machine		
	₹	₹	₹		₹
Revenue		10,00,000			12,50,000
Less : Operating cost	1,00,000			50,000	
Depreciation 1,20,000/12	10,000	1,10,000	5,00,000/10	50,000	1,00,000
Taxable income		8,90,000			11,50,000
Income tax @ 50%		4,45,000			5,75,000
Profit after tax		4,45,000			5,75,000
Add : Depreciation		10,000			50,000
Net cash flows		4,55,000			6,25,000

Note : New machine is to be selected as it has higher net cash flow.

Present value of cash flows of 10 yrs. @ 12% discount rate (i.e. 5.65)	25,70,750	35,31,250

new machine is to be purchased as there is a net present value gain of
₹ (35,31,250 – 25,70,750) = ₹ 9,60,500.

12. (a) A factory has capacity to provide 599 hours per week. The plant can produce Product A and Product B. Annual costs are Rs 15000. Maximum possible sales were estimated to be

5000 units for Product A and 4000 units of Product B. Other information available are as follows:

	Product A	Product B
Variable Cost per unit	**9**	**12**
Selling Price per unit	**15**	**18**
Hours required per unit	**5**	**6**

Find out product mix that will maximize profit.

(b) Data relating to output and input for a firm for the last year are furnished below :

		₹
Output	**:**	**50,000**
Labour	**:**	**10,000**
Material	**:**	**5,000**
Capital	**:**	**12,500**
Energy consumed	**:**	**2,500**
Other expenses incurred	**:**	**1,250**

Comment on the following statements in the context of the information furnished above :

(i) The total factor productivity of the firm has been higher as compared to the total productivity because the total productivity takes into account all the factors of production.

(ii) Labour productivity is low as the firm is capital intensive with the capital input being higher.

Answer:

12. (a)

	Product A	Product B
Contribution per unit(SP-VC) ₹	15-9=6	18-12=6
Contribution per hr. (Contribution per unit/hours req. per unit- ₹)	6/5=1.2	6/6=1

Thus Product A should be given priority. In order to produce 5000 units, hours required is 5000*5=25000Hours.
Total Hrs. available=599*52=31148
Hrs. left=31148-25000=6148
Units of Product B that can be produced=6148/6=1025approx.
Optimum Product mix is as follows:
A-5000
B-1025

(b) Total factor productivity (in per cent)

$$= \frac{\text{Output}}{\text{Labour} + \text{Material} + \text{Capital} + \text{Energy Consumed}} \times 100$$

$$= \frac{50,000}{10,000 + 5,000 + 12,500 + 2,500} \times 100 \qquad = 166.67\%$$

Total productivity (in per cent)

$$= \frac{\text{Output}}{\text{Labour} + \text{Material} + \text{Capital} + \text{Energy Consumed} + \text{Other Expenses}} \times 100$$

$$= \frac{50,000}{10,000 + 5,000 + 12,500 + 2,500 + 1,250} \times 100 \quad = 160\ \%$$

Labour productivity (in per cent) = (Output / Labour) x 100
= (50,000/ 10,000) x 100
= 500%

Capital productivity (in per cent) = (Output/ Capital) x 100
= (50,000 / 12,500) x 100
= 400%

(i) The total factor productivity of the firm is higher because it has not considered other expenses incurred.
(ii) The statement is not true since labour productivity is more that the capital productivity.

13. (a) A firm received an order to make and supply eight units of standard product which involves intricate labour operations. The first unit was made in 10 hours. It is understood that this type of operations is subject to 80% learning rate. The workers are getting a wage rate of ₹12 per hour.

(i) What is the total time and labour cost required to execute the above order?

(ii) If a repeat order of 24 units is also received from the same customer, what is the labour cost necessary for the second order?

(b) X Ltd. must choose whether to go ahead with either of two mutually exclusive projects A and B. The expected profits are as follows:

	Profit if there is Strong Demand	Profit/(loss) if there is Weak Demand
Project A (₹)	**4,000**	**(1,000)**
Project B(₹)	**1,500**	**500**
Probability of demand	**0.3**	**0.7**

(i) What should be the decision based on expected values, if no information about demand were available?

(ii) What is the value of Perfect Information about the demand?

Answer:

13. (a) 80% learning curve results are given below-

Production (Units)	Cumulative Avg. Time(Hours)	Total Time (hours)
1	10	10
2	8	16
4	6.4	25.6
8	5.12	40.96
16	4.096	65.54
32	3.2768	104.86

Labour time required for the first eight units = 40.96 hours
Labour cost required for 8 units = 40.96 hours × ₹12/hr = ₹491.52
Labour time for 32 units = 104.86 hours
Labour time for first eight units = 40.96 hours
Labour time required for 2nd order of 24 units =36.90 hours

Labour cost for 24 units =63.90 hours × ₹12/hr = ₹766.80

(b) (i) When no information for demand is available, the project with higher EV of profit would be selected.

	Project A		Project B	
Probability	Profit	EV	Profit	EV
0.3	4,000	1,200	1,500	450
0.7	(1,000)	(700)	500	350
1.0		500		800

The EV of B is greater than EV of A, therefore project B would be selected.
Project B better option, if the demand turns out to be weak, but if the demand turns out to be strong then option A is a better option with 30% probability.

(ii) If perfect information for demand is available then it would indicate whether the demand will be weak or strong. Demand if forecasted to be weak then project B should be selected. However, if demand is projected as strong then project A shall be selected.

Perfect information would improve the profit from ₹ 1,500 which would have been earned, by selection B to ₹4000 from A.

Forecast Demand	Probability	Project Chosen	Profit	EV of Profit
Weak	0.7	B	500	350
Strong	0.3	A	4,000	1,200
EV of profit with perfect information				1,550

	(₹)
EV of profit without perfect information	800
(i.e. choose B all the time)	
EV of profit with perfect information	1550
Value of perfect information	750

The information provided should not cost more than 750 to collect, and then only it would be worth it.

14. (a) A product comprised of 10 activities whose normal time and cost are given as follows:

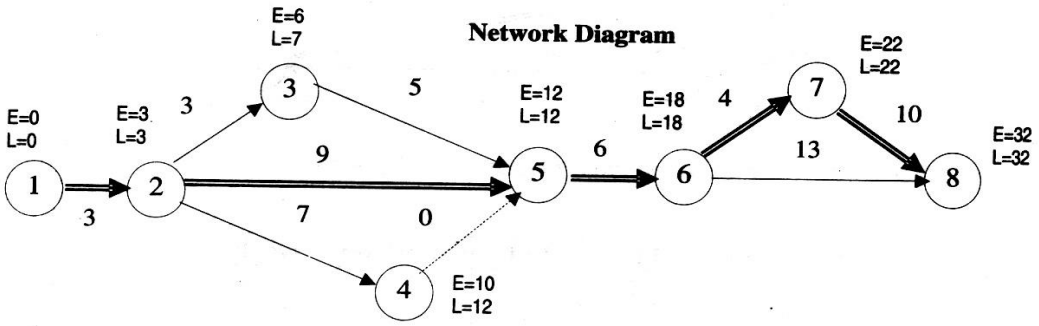
Activity	**1-2**	**2-3**	**2-4**	**2-5**	**3-5**	**4-5**	**5-6**	**6-7**	**6-8**	**7-8**
Normal Time (days)	**3**	**3**	**7**	**9**	**5**	**0**	**6**	**4**	**13**	**10**
Normal Cost (₹)	**50**	**5**	**70**	**120**	**42**	**0**	**54**	**67**	**130**	**166**

Indirect Cost is ₹ 9 per day.

1. **Draw the Net work and identify the Critical Path.**
2. **What is the Project Duration and Associated Cost?**
3. **Find out the Total Float associated with each activity.**

Answer:

14. (a)



Critical Path 1-2-5-6-7-8
Project Duration 32 days.
(Note: Observer the use of Dummy Activity, where Time & Cost=0)

Network Table

Activity	Duration	EST	LST	EFT	LFT	TF	Normal Cost
1-2	3	0	0	3	7	0	50
2-3	3	3	4	6	10	1	5
2-4	7	3	4	10	11	1	70
2-5	9	3	3	12	12	0	120
3-5	5	6	7	11	12	1	42
4-5	0	10	12	10	12	2	0
5-6	6	12	12	18	18	0	54
6-7	4	18	18	22	22	0	67
6-8	13	18	19	31	32	1	130
7-8	10	22	22	32	32	0	166
							714

Project Duration = 32 days
Associated Cost = Normal Cost + Indirect Cost = ₹ 714 + (₹ 9 x 32) = ₹ 1002

15. (a) Four products A,B,C and D have ₹5, ₹7, ₹3 and ₹9 profitability respectively.
First type of material (limited supply of 800 kgs.) is required by A,B, C and D at 4 kgs, 3 kgs, 8 kgs and 2 kgs respectively per unit.
Second type of material has a limited supply of 300 kgs, and is for A,B,C, and D at 1 kg, 2 kgs, 0 kg and 1 kg per unit. Supply of other type of materials consumed is not limited. Machine hrs. available are 500 hours and the requirements are 8,5,0,4 hours for A,B,C and D each per unit. Labour hours are limited to 900 hours and requirements are 3,2,1 and 5 hours for A,B,C and D respectively.
How should the firm approach so as to maximize its profitability? Formulate this as a linear programming problem. You are not required to solve the LPP.

(b) The following costs have been recorded:

Particulars	₹
Incoming materials inspection	10,000
Training of personnel	30,000
Warranty	45,000
Process planning	15,000

Scrap	**9,000**
Quality laboratory	**30,000**
Rework	**25,000**
Allowances	**10,000**
Complaints	**14,000**

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

Answer:

15. (a)

Particulars	A	B	C	D	Total Available
Profit per unit	5	7	3	9	
Material 1 (kg. per unit)	4	3	8	2	800
Material 2 (kg. per unit)	1	2	0	1	300
Machine Hours (per unit)	8	5	0	4	500
Labour Hours (per unit)	3	2	1	5	900

The Objective of the firm is to maximize the profitability which is subject to the limited availability of resources.

Let $X_1, X_2 X_3$ & X_4 be the units produced of A,B,C & D respectively.

Objective Function-

$Z_{MAX} = 5X_1+7X_2+3X_3+9X_4$

Subject to –

Material 1: $4X_1+3X_2+8X_3+2X_4 \leq 800$

Material 2: $1X_1+2X_2+0X_3+1X_4 \leq 300$

Machine Hour: $8X_1+5X_2+0X_3+4X_4 \leq 500$

Labour Hours: $3X_1+2X_2+1X_3+5X_4 \leq 900$

(b)

Particulars	₹
Training of personnel	30,000
Process Planning	15,000
Total Cost of prevention	**45,000**
Incoming materials inspection	10,000
Quality laboratory	30,000
Total cost of Appraisal	**40,000**
Scrap	9,000
Rework	25,000
Total cost of Internal Failure	**34,000**
Warranty	45,000
Allowances	10,000
Complaint	14,000
Total Cost of External Failure	**69,000**

SECTION II – Information Systems

1. (a) Put an appropriate word or phrase in blank position.

(i) Transferring programs from main memory to disk storage and back is called……

(ii) ……..refers to behaviour of computer system which seems to be intelligence of the computer itself.

(iii) …… is a program used to eliminate errors in the program.

(iv) In……..information system architecture, each workstation has equivalent capabilities and responsibilities.

(v) ……..is an electronic device which carries multiple signals on a single carrier at a time.

(vi) The activities of an Information System is collection, generation and ……. of information to right users.

(vii) Multiprogramming is processing of a number of programs simultaneously by using the technique of ----------.

(viii) A ----------is a set of standards or rules.

(ix) ----------is a language system that delivers programs to users which can then be run on the users' machines.

(x) The range of frequencies available for data transmission is called-------.

(b) Expand the following abbreviations:

MOTIS
OOPS
B-ISDN
RADIUS
EBCDIC
OLAP
SET
OLE
SVGA
SDLC

(c) State whether following statements are true or false:

(i) Hierarchical database structure cannot represent 'many to many' relationship.
(ii) Network OS controls hardware devices, software, communication media and channels.
(iii) Mail server sends mail to e-mail address of the receiver.
(iv) DBMS software does not support query language.
(v) Virtual memory is provision of secondary storage which acts as secondary memory.
(vi) Data security and data privacy mean the same thing.
(vii) The higher the management, more structured are the problems.
(viii) Sequential files are suited for on-line inquiry processing.
(ix) Real time processing has fixed time constraints.
(x) In Binary Numbering System 'bits' and 'bytes' convey different meaning.

Answer:

1. (a) (i) Swapping
(ii) Artificial Intelligence
(iii) Debugging
(iv) Peer-to-peer
(v) Multipexer
(vi) Dissemination

(vii) Time Sharing
(viii) Protocol
(ix) Java
(x) Bandwidth

(b) **MOTIS-** Message oriented Text Interchange System
OOPS- Object Oriented Programming System.
B-ISDN- Broadband- Integrated Services Digital Network
RADIUS- Remote Authentication Dial In User Service
EBCDIC- Extended Binary Coded Decimal Interchange.
OLAP- On-line Analytical Processing
SET - Secure Electronic Transaction.
OLE - Object Linking & Embedding
SVGA - Super Video Graphics Adapter
SDLC - System Development Life Cycle

(c) (i) True
(ii) True
(iii) True
(iv) False
(v) False
(vi) False
(vii) False
(viii) False
(ix) True
(x) True

2. Differentiate Between:

(a) Client-Server Model and Peer- to -Peer Model
(b) Intranet and Extranet
(c) Transmission Control Protocol and Internet Protocol
(d) BPO and BPR
(e) Interpreter and Compiler
(f) Multiprogramming and Multiprocessing
(g) System Software and Application Software

Answer:

2. (a) **Client-Server Model and Peer- to -Peer Model**

	Client-Server model	**Peer-to-Peer model**
1.	In this model, number of computers, known as clients are connected to a single host computer known as server.	In this model, all the computers are interconnected with each other. There is no concept of server and clients. All computers behave as server as well as clients.

2.	It uses a dedicated server which provides various services to clients like hardware, software and data access. Different types of servers can be File, Fax, Print or Database server.	It uses non-dedicated server. Non-dedicated server can also be used as a node for data entry, processing and output operations.
3.	Clients can share disk storage and printers attached with the server.	All computers can share the data/resources of each other.
4.	It is suitable for large organization having large number of nodes.	It is suitable in small organization having less number of nodes upto ten.
5.	Data transfer speed is more.	Data transfer speed is less which decreases even further with the increase in number of computers.
6.	Failure of server results in break-down of entire network.	Failure of one computer will not affect the working of other, only the data stored on the faulty computer will not be accessible to other computers.
7.	Server cannot be used for data entry/result purposes, hence it can be said that all the computers are not fully employed.	All the computers are fully employed.
8.	Clients are required to be connected with server in a particular structure like Star Network.	Computers can be connected at any convenient point in the network like Ring Network.
9.	Clients can be dumb terminal or Intelligent terminals.	All computers are intelligent terminals.
10.	This architecture is employed where data security is of prime importance.	This architecture is used when security is not a bigger issue.

(b) Intranet and Extranet:

Intranet is a type of information system that facilitates communication within the organization, among widely dispersed departments, divisions and regional locations. Intranets connect people together with Internet technology, using web browsers, web servers and data warehouses in a single view. With an Intranet, access to all information, applications and data can be made available through the same browser. The objective is to organise each individual's desktop with minimal cost, time and effort to be more productive, cost efficient, timely and competitive.

An **Extranet** is an extension of an Intranet that makes the latter accessible to outside companies or individuals with or without an Intranet. It is also defined as a collaborative Internet connection with other companies and business partners. Parts of an Intranet are made available to customers or business partners for specific applications. The Extranet is thus an extended Intranet, which isolates business communication from the Internet through secure solutions. Extranets provide the

privacy and security of an Intranet while retaining the global reach of the Internet. An Extranet extends the Intranet from one location to another across the Internet by securing data flows using cryptography and authorization procedures, to another Intranet of a business partner.

(c) TCP/IP is the most popular protocol for exchange of information between networks. It is also known as Point to point protocol.

TCP part deals with assembling and disassembling of data packets i.e. creating data packets from the files to be transferred etc. TCP is optimized for accurate delivery rather than timely delivery.

IP part handles forwarding or routing of data packets on internet channels, from source to destination i.e. it handles transfer of data packets on channels.

(d) Business Process Outsourcing (BPO) means outsourcing or sub contracting a business process which cannot be done in house or is optimum if done outside. Business process outsourcing is a subset of outsourcing that involves the contracting of the operations and responsibilities of specific business functions to a third-party service provider. Originally, this was associated with manufacturing firms, such as Coca Cola that outsourced large segments of its supply chain.

Business Process Reengineering (BPR) refers to the analysis and redesign of workflows and processes both within and between organizations. The orientation of the redesign effort is radical, i.e. it is a total deconstruction and rethinking of a business process in its entirety, unconstrained by its existing structure and pattern. Its objective is to obtain quantum gains in the performance of the process in terms of time, cost, output, quality and responsiveness to customers. The redesign effort aims at simplifying and streamlining a process by eliminating all redundant and non-value adding steps, activities and transactions, reducing drastically the number of stages or transfer points of work and speeding up the work-flow through the use of it systems.

(e)

Interpreter	Compiler
(i)Translates line by line	Translates the whole program
(ii)Translation takes place during execution	Translation happens in one go
(iii)Execution time is high	Execution is fast
(iv)Requires less memory	Requires more memory
(v)Cost of software is less	Cost of software is high.

(f)

Multiprogramming	Multiprocessing
Multiprogramming is defined as execution of two or more programs that reside in primary storage.	A system having more than one central processing unit or having number of processors.
There is concurrent execution of instructions of programs in a multiprogramming feature system.	There is a simultaneous execution of co-ordinated work in multiprocessing feature system.

Multiprogramming feature is used for personal and organizational tasks which are not very complex.	Multiprocessing feature is generally used for complex tasks and in large organizations e.g. it is used in rail road control, traffic control or airways etc.
Systems with multiprogramming features have lesser data processing capabilities when compared to a system with multiprocessing features.	Systems with multiprocessing feature have larger data processing capabilities.
Processing speed is gained through use of technique called buffering.	High processing capability is gained through co-ordination of processors.

(g) System software is computer software designed to operate and control the computer hardware and to provide a platform for running application software. It comprises of those programs that controls and support the computer system and its data processing applications. Operating system may be a group of software used for managing the different functions of computer system e.g. allocation of resources to different jobs, control of input/output, memory management etc.

Application Software is computer Software designed to help the user to perform specific tasks. General purpose application software such as electronic spreadsheet has wide application Specific purpose application software such as payroll and sales analysis is used only for the application for which it is designed.

3. Explain the terms:

(a) Data Warehouse.
(b) AI
(c) Firewall
(d) Flow Chart

Answer:

3. (a) The data warehousing is the concept of data integration by way specialized data storage and retrieval technique. The core of data warehousing is multi-dimensional databases. The basic objective of data warehousing is give right kind of expert analysis of data and feed the decision makers with right kind of information for effective decision to run the business efficiently.

The need for data warehousing has come from increased competition and demand for more and accurate information for precise decision making. Data warehousing can translate the data in common format and store them scientifically for faster access. Combining the related data is the crux in the approach of data warehousing. Thus, database design has a definite key role in making the storage efficient. Providing sensible information is only possible through analysis of related data.

Steps involved:

- Development of hardware and software infrastructure
- Building sound corporate database
- Establishment of communication network
- Managing smooth data flow from multiple operational points
- Building proper check and security measures from misuse

Critical factors involved in data warehousing:
- Heterogeneous data set and their translation in common format
- Organization of database
- Capability of software tool
- Judgement on transactional period for storage of data

Advantages:
- Effective, efficient and convenient data storage
- Elimination of duplication
- Lower storage of cost
- Faster navigation through related information
- Reliable data
- Consistency in reporting
- Better decision making

Strategic use of data warehousing in different business environments:
- Customer Service
- Sales Promotion
- Market analysis of new products

(b) Artificial Intelligence refers to behaviour of computer system which seems to be intelligence of the computer itself. As you know the computer does not have power to act on its own, the intelligent solutions from a computer system is termed to be Artificial Intelligence. In fact, this phenomena is exhibited by a computer system out of the expertise of the software which has the capability to interpret the problem situation and use the knowledge base to evolve intelligent solutions. The artificial intelligence is closely associated with expert system. It is only the expert system which can exhibit artificial intelligence.

(c) Firewalls offer an effective system to protect access by unauthorized user from outside. The main feature of firewall is packet-filtering router so that vital information does not pass to any unauthorized intruder, even if he manages get access to the network system. It is a system of security in the network with the help of hardware and software. A software checks all incoming and outgoing internet traffics. The firewall routes the massages to a safe area to avoid any danger in the in forward transmission of messages. The screening by firewall software may delay the transmission process but ensures proper security.

Limitations of Firewall
- Passing on information by internal employees through internet cannot be checked.
- Firewall cannot protect the system from virus.

(d) Flow Chart is the diagrammatic representation of the algorithm i.e. program logic. It uses a unique set of symbols to describe the conditions and actions.

Technique of in drawing flow chart
- Starting with the input for main decision factor
- Putting the condition in the decision box
- Branching the condition into different path of decision box
- Branching should be done without ambiguity
- To remove ambiguity, more than one decision box may be used

- Writing the statements under each branch
- Avoiding crosses in the flow chart
- Using connectors to reduce the number of flow lines, if required.

Advantages of Flow Charts:

- Logical representation of problem steps
- Flow chart helps to make the complex logic simpler
- A visual aid in conceptualization of the problem
- It is tool for efficient programming
- Helps in debugging
- Support program documentation

4. (a) Define Fourth Generation Languages.
(b) What is Data Redundancy?
(c) "Time sharing and real time processing are two important features of an operating system that generally influence our present day life." –Justify this statement.

Answer:

4. (a) **Fourth Generation Languages(4GLs),** can be used by both programmers and non-programmers. 4GL uses English like instructions, has limited mathematical manipulation capability. It offers automatic report formatting, sequencing and record selection by user given criteria. However, 4GLs are less efficient than third generation languages. They require specification of what task to perform and the system determines how to perform that task. 4GL requires fewer instructions, code is easy to maintain and understand. Many features of 4GLs can be learned quickly. 4GLs are more structured and are data base oriented. Generally, these are available in two types (i) Production Oriented and (ii) User Oriented.

(b) One of the basic problem in traditional file management is that there us duplication of data, that is, data redundancy. Data redundancy occurs because different divisions, functional areas, and other groups of the organization collect the same piece of information independently. For example, in a banking organization, information from the same group of customers might be collected by its marketing department as well as by its credit information department. This happens because both the departments may use the information to solve their own problems which may be different but the types of information remain the same. There are several such instances. This system not only results into wastage of efforts but also creates confusion in the minds of those who are involved in data processing.

(c) Time sharing and real time processing are two important features of an operating system that generally influence our present day life.
Time sharing is concurrent or simultaneous sharing of computing resources among many users. It allows large number of users to interact concurrently with a single computer. It divides or allocates the available time of CPU among many users and that time slot or time slice execute the user task. The time slot is allocated at such as high speed to each user that the user feels like CPU is working for his task only. Time-sharing has dramatically lowered the cost of providing computing capability and has promoted the interactive use of computers and the development of new interactive applications.
Main advantage of time-sharing technique is the reduction in response time in multi user mode. It provides immediate response to user's request for execution of any task by immediately allocating a time slot to each user's task.

In Real time system a transaction is updated to the system instantly as soon as it occurs originally. The input data is processed as soon as it is fed so that further decision can be taken promptly on the basis of updated records. A real time system is an online processing system but in a real time mode. Real time processing of transactions is a must for certain kinds of industry.

5. (a) Which areas of DBMS should be addressed while maintaining a database? Explain.
(b) What are the different components of Database Management Systems? Define each of them in two or three sentences.
(c) What is the role of System Analyst?

Answer:

5. (a) Following five areas of DBMS managements are be considered when trying to maintain a well-tuned database:

(i) Installation of database
- Correct installation of the DBMS product.
- Ensuring that adequate file space is available.
- Proper allocation of disc space for database.
- Allocation of data files in standard sizes for I/O balancing.

(ii) Memory Usage – One should know about following memory management issues:
- How the DBMS uses main memory?
- What buffers are being used?
- What needs the programs in main memory have?

Knowledge of above issues can help in efficient usage of memory.

(iii) Input / Output (I/O) contention
- Achieving maximum I/O performance is one of the most important aspects of tuning. Understanding how data are accessed by end-users is critical to I/O contention.
- Simultaneous or separate use of input and / or output devices.
- Clock speed of CPU requires more time management of I/O.
- Spooling/Buffering etc. can be used.
- Knowledge of how many and how frequently data are accessed, concurrently used database objects need to be striped across disks to reduce I/O contention.

(iv) CPU Usage
- Multi programming and multi processing improve performance in query processing
- Monitoring CPU load.
- Mixture of online/back ground processing need to be adjusted.
- Mark jobs that can be processed in run off period to unload the machine during peak working hours.

(b) Database Management System has the following components:

(i) **Database administrator** – Database administrator is a person who is responsible for defining, updating and controlling access to a database. He has the central control over the system.

(ii) **Database users** – There may be different types of users of database. Based on the types of interface the users have with the database they can be classified into four categories: Application programmers, specialized users, Naïve users and end users.

(iii) **Database software** – This includes both the system software and other supporting application software that are used to work on the database. database software is, thus a set of instructions required to manage, maintain and work with the data

(iv) **Database** - A database is a collection of data files integrated to minimize duplication of data and to provide convenient access to information within that system to satisfy a variety of users needs.

(c) The role of System Analyst is:

- To analyze existing systems , procedures and documents
- To develop ideas for improved/new system
- To design system specifications with input, output and file specifications
- To design control system with audit trail
- To define actions/decisions/error messages under various conditions
- To prepare user and operations manual
- To prepare implementation plan(parallel/pilot/phased/direct switch over)
- To prepare program specifications with test data and monitoring results
- To provide guidance to programmers
- To make interaction with users.

6. (a) In a payroll system, the employee master file is being designed to have records of fixed length consisting of the following fields:

Field Name	Maximum Field Size
Employee Number	**6**
Employee Name	**35**
Designation	**10**
Date of Birth	**6**
Date of Joining	**6**
Section Code	**3**
Qualification	**20**
Training Codes	**10**
Scale of Pay	**10**

The Employee Master has 2000 employee records presently. Once an employee leaves, his record is deleted. However, it is estimated that there may be fresh recruitment up to 15% of present strength in future. The file management software also requires an overhead of 20% for minimizing probabilities of collision and overflow conditions. Compute the total file space requirement after allowing for 10% contingency factor in total.

(b) What is meant by RDBMS? Name two commonly used RDBMS.

Answer:

6. (a)

Field Name	Maximum Field Size
Employee Number	6
Employee Name	35
Designation	10
Date of Birth	6
Date of Joining	6
Section Code	3
Qualification	20
Training Codes	10

Scale of Pay	10
Total Size	106

Record length = 106.
Total length of 2000 records = 2000 × 106 = 212000.
Adding 15% for fresh recruitments = 1.15 × 2000 × 106 =243800.
Adding 20% for overhead to minimize collision = 1.20 × 243800 = 292560.
Adding 10% for contingency = 1.10 × 292560 = 321816.
Hence total file space requirement = 321816.

(b) In Relational Database Structures, records are stored in the form of two dimensional tables. The table is a file, in which each row represents one record and each column represents a field. In this database structure, relationships between the records need not to be specified in advance. Relational databases provide the flexibility in performing database queries and creating reports from more than one file by establishing the relationship among them on the basis of primary key. This relationship among the files can be created at any time according to the requirement and need not to be specified at the time of creation of database files.

The relational database structure is more flexible than hierarchical or network database structures in providing answers of adhoc reports but it does not process the large batch applications with the speed of hierarchical or network databases.
Examples of Relational Database Management Systems include Oracle, IBM DB2 SQL Server, MS-Access etc.

7. (a) Give a definition of MIS. Why are information systems for managers difficult to design and build?
(b) What are the objectives of information system audit?
(c) Describe the significance of benchmarks. What are the three categories of control?

Answer:

7. (a) A management information system or MIS is an information system making use of available resources to provide managers at all levels in all function with information from all relevant sources to enable them to make timely and effective decisions for planning, directing and controlling the activities for which they are responsible.

A MIS is a comprehensive and coordinated set of information sub-systems which are rationally integrated and which transform data into in a variety of ways to enhance productivity in conformance with managers' styles and characteristics on the basis of established quality criteria.

Information Systems are difficult to design and build due to the following reasons:

(i) Much of the information needed by the managers are future oriented or comes from outside sources.
(ii) Much of the information needed by the managers is for one-of-a-kind, which are difficult to anticipate and provide for in the system.
(iii) Managers receive much of their information from discussions with people rather than from reports and statements.
(iv) Managers and computer professionals often fail to understand each other. Channel of communication between them are often blocked by

misconceptions, misunderstandings and jargons.

(v) Many managers lack computer and systems knowledge, and hence lack trust in MIS.

(vi) Computer professional do rarely understand management processes. Hence, MIS designed and build by them often fail to satisfy the managers.

(b) The objectives of information systems audit are as follows:

- Safeguarding of assets which include hardware, software, people i.e. knowledge, data files, system documentation etc.
- Data integrity i.e. completeness, soundness, purity and veracity,
- System effectiveness i.e. it has knowledge of user needs and facilitates decision making process in the organization,
- System efficiency i.e. use of minimum resources to fulfill the desired objectives, and
- Statutory compliance i.e. rules, regulations, or conditions to be complied with under various Acts, Laws, and Regulations etc.

(c) Bench marking is the process of comparing one's business processes and performance metrics to industry bests and best practices.
Significance of Benchmarks: Benchmark is a set of conditions against which a product or system is measured. In other words, it forms the basis or standards of measurements for evaluating performance of system under simulated conditions.
Benchmark helps accomplish better and realistic results.
The different categories of controls are:
Preventive controls are those inputs which are designed to prevent error & omission.
Detective controls are those controls which detect & report the error & omission.
Corrective controls are designed to reduce the impact or correct an error once it has been detected.

8. Define
(a) Audit Trail
(b) Outsourcing in Information System
(c) Information System Audit

Answer:

8. (a) Audit trail refers to a system of designing of an information system in a manner that the historic data and information at any processing stage may be traced to verify the origin, correctness, authenticity, flow and destination including the stages of security procedures for establishment of integrity of data and information.

(b) Outsourcing may be defined as the use of parties, external to the organisation, to provide goods or services to the organisation. Outsourcing in today's economic environment is considered as an important means of improving an organisation's competitiveness and profitability. By outsourcing an organisation can pay more attention to its core competitiveness and take advantage of other organisation's core competencies.

Any organisational function may be a point of consideration for outsourcing e.g. legal services, security, any manufacturing process, supply of components for the products, and even the information system itself.

The reasons for outsourcing of information system function are:

1. exercising greater control over the information system function if it is outsourced e.g. vendors being more responsive to user needs, sharing economies of scale achieved by the vendor and restricted consumption of information system resources which are no longer free.
2. Innovative approach because of access to new technology and expertise expected from the vendor.

There is some preparatory work before a decision on outsourcing of information system services can be taken. Such work is of the following nature:

1. It should be determined what part of information system activities can be outsourced, what are strategic to the organisation, and whether suitable (expert, dependable, financially viable and reliable) vendors exist.
2. Terms and conditions of the contract including termination clause for outsourcing should be determined incorporating scope of work, audit rights, performance criteria, responsibilities etc.
3. Monitoring compliance with the terms and conditions.
4. Impact on the organisation.
5. Procedures for outsourcing disaster recovery control

(c) Information system audit is the process of examining and evaluating of adequacy and effectiveness of internal controls. Information system audit will examine and evaluate the planning, organizing and directing processes to determine whether reasonable assurance exists that objective and goals will be achieved.

9. (a) What are the eight basic features of an MIS?
(b) Describe Firewall. What are its limitations?
(c) Write short notes on Access control.

Answer:

9. (a) Basic features of an MIS:
   (i) **Management Oriented** – It means the effort for development of the information system should start from an appraisal of management needs and overall business objectives.
   (ii) **Integrated** – Development of Information should be an integrated one. It means all the functional and operational information sub-system should be tied together into one entity.
   (iii) **Reliability** – MIS system should provide most reliable information. A thorough check of input information, process flow and output reports on regular and routine basis
   (iv) **Flexibility** – MIS should be flexible enough to take care of changes in the environment in the business system.
   (v) **Consistency-** The input data and output reports must follow some standard norms so that consistency is preserved.
   (vi) **Timeliness** – One of the most important issues involved in the effectiveness of MIS are flow of information at right time to the user level of management.
   (vii) **Relevance** – Only relevant information should flow at different levels of management to increase the effectiveness of MIS.
   (viii) **Simplicity** – An MIS System should be as simple as possible so that people at operation and users do not feel any hazards. The success of a system lies in the acceptance by operation staff and users.

(b) Firewalls offer an effective system to protect access by unauthorized user from outside. The main feature of firewall is packet-filtering router so that vital information does not pass to any unauthorized intruder, even if he manages get access to the network system. It is a system of security in the network with the help of hardware and software. Software checks all incoming and outgoing internet traffics. The firewall routes the massages to a safe area to avoid any danger in the in forward transmission of messages. The screening by firewall software may delay the transmission process but ensures proper security.

Limitations of Firewall

- Passing on information by internal employees through internet cannot be checked.
- Firewall cannot protect the system from virus.

(c) Access to computer should be restricted to authorized persons only to prevent fraud, damage and ensure better security of information and assets. For this purpose, a security policy and framework must be devised.
The primary control for security purpose is access control. Access control is executed with the following checks:

- Permission to level of access to system depending on category of user.
- Periodic change of password should be made mandatory.
- Password of System Administrator should be kept in safe custody under sealed cover.
- Access restricted to only users presently working in the Department/Branch.
- Use of Standard Anti-virus software in all PC's.

10. (a) State the steps involved in implementation of MIS.
(b) Briefly explain five categories of Computer frauds based on the data processing model.

Answer:

10. (a) For establishment of MIS in an organization, the following steps are followed:

Analytical study on information requirement: A joint efforts by systems experts and management experts is required to understand the exact need of information at different levels of management and how to assimilate them from data flow from different sources. The anticipated change in the need of information may be kept in mind while planning the design in order to provide sufficient flexibility in the system.

Determine the sources of information: Once the first step is understood, it is to see how to get the required information and their sources. If required, data recording system may be changed at different points so that exact data flow is ensured and the same can be done without much hazards. For the sake of simplicity of the system reorientation in the physical flow of data has to be done.

Establishment of right kind of data processing environment: The important step involved in MIS designing is arranging the right kind of tools for processing i.e., Computer System and infrastructure in terms of software and skilled manpower. The proper scheduling of processing is equally important to ensure smooth flow of information.

Selection of software: One of the important factors of success for MIS is quality of software. Software must fulfill the following criteria:

- Compatibility of hardware

- Capable of taking load of data volume
- Have the support of software for required database
- Capable of supporting the communication network
- Satisfy the design specification of system architecture – Central data processing or distributed data processing

Database design: In database design the important issues involved are sub-systems in the organization and the logic of integration. Technical knowledge of database and knowledge of application systems, their control requirements and designing of reports are essential for efficient designing of database.

Support of top management: To ensure the smooth functioning of MIS top management support is required. Top management will support only when they are convinced about the benefit of MIS of the organization and confident of efficient performance of processing and regular reporting. Thus, for support of top management, efficiency of MIS has to be established.

Manpower: Arrangement of right kind of manpower with proper skill is the most consideration for successful operation of the system. Proper planning for training of manpower involved in transaction processing and report generation under an MIS system is required to take care of future development of the system.

Integration of information: At the time of designing the data bases, provision for integration of information from different sub-systems is essential so that comprehensive information flow can be of great use for strategic planning.

Evaluation, maintenance and Control: The effectiveness of an MIS system is evaluated by the capacity of its fulfillment of requirement of information by the management. Evaluation is done by ascertainment of the views of the users. Maintenance is needed to take care of the gaps, if any, for further growth and for regular smooth functioning of the system. Control means establishment of checks for input data, processing and output to ensure correctness of reports. Proper maintenance and control on effective operation of MIS required to ensure protection from hazards and smooth functioning on a routine basis.

(b) Based on data processing model computer frauds can be categorized into following categories:

(i) **Input:** The simplest and most common way to commit a fraud is to alter computer input, it requires little, if any, computer skills. Instead, perpetrators need only to understand how the system operates so that they can cover their tracks. Collusive fraud, disbursement frauds, payroll and receipt frauds are examples of computer frauds committed through computer input.

(ii) **Processor:** Computer fraud can be committed through unauthorized system use, including the theft of computer time and services. For example, some companies do not allow their employees to use company computers to keep personal or outside business records. Violating this policy would constitute a fraud. Similarly, employee goofing is also considered to be computer fraud.

(iii) **Computer instructions:** Computer fraud can be accomplished by tampering with the software that processes company data. This may involve modifying the software, making illegal copies of software or using it in an unauthorized manner.

It might also involve developing a software program or module to carry out an unauthorized activity. This approach to computer fraud used to be one of the least common, because it requires a specialized knowledge of computer programming that is beyond the scope of most users.

(iv) **Data:** Computer fraud can be perpetrated by altering or damaging a company's data file or by copying, using them without authorization. There have been numerous instances of data files being scrambled, altered or destroyed by some selfish employees.

(v) **Output:** Computer fraud can be carried out by stealing or misusing system output. System output is usually displayed on monitors or printed on paper. Unless properly safeguarded, monitor and printer output is subject to pry eyes and unauthorized copying.

11. (a) Explain the process of evaluation of various ERP packages.

(b) How will you establish and implement Critical Success Factors (CSFs) and Key Performance Indicators (KPIs) is an organization for achieving the benefits of implementation of ERP?

Answer:

11. (a) Evaluation of ERP packages is done based on the following criteria**:**

(i) **Flexibility:** It should enable organizations to respond quickly by leveraging changes to their advantage, letting them concentrate on strategically expanding to address new products and markets.

(ii) **Comprehensive:** It should be applicable across all sizes, functions and industries. It should have in depth features in accounting and controlling, production and materials management, quality management and plant maintenance, sales and distribution, human resources management and plant maintenance, human resources management and project management. It should also have information and early warning systems for each function and enterprise – wide business intelligence system for informed decision making at all levels.

It should be open and modular. It should embrace an architecture that supports components or modules, which can be used individually, expandable in stages to meet the specific requirements of the business including industry specific functionality. It should be technology independent and mesh smoothly with in house / third party applications, solutions and services including the web.

(iii) **Integrated:** It should overcome the limitations of traditional hierarchical and function oriented structures. Functions like sales and materials planning, production planning, ware house management, financial accounting, and human resources management should be integrated into a work flow of business events and processes across departments and functional areas, enabling knowledge workers to receive the right information and documents at the right time at their desktops across organizational and geographical boundaries.

(iv) **Beyond the Company:** It should support and enable inter-enterprise business processes with customers, suppliers, banks, government and business partners and create complete logistical chains covering the entire route from supply to delivery, across multiple geographic, currencies and country specific business

rules.

(v) **Best Business Practices:** The software should enable integration of all business operation in an overall system for planning, controlling and monitoring. It should offer a choice of multiple ready-made business processes including best business practices that reflect the experience and requirements of leading companies across industries. It should intrinsically have a rich wealth of business and organizational knowledge base.

(vi) **New Technologies:** It should incorporate cutting edge and future proof technologies such as object orientation into product development and ensure inter- operability with the Internet and other emerging technologies.

(vii) Other factors to be considered are:

- Global presence of the package
- Local presence
- Market targeted by the package
- Price of the package
- Obsolescence of package
- Ease of implementation of package
- Cost of implementation
- Post –implementation support availability.

(b) Effective use of ERP is a direct result of steps taken at the time of implementation toward preparing the organization. Change integration has to be necessarily embedded in the task list for any ERP implementation. The main tool for this is the process of communication in all forms-written, oral, workshops, meetings and follow up activities. The process should start quite early by educating all layers of the management on the particular ERP product, its relevant functionality, limitations and benefits.

Also at the start of the project, the Critical Success Factors (CSFs) for the company as whole should be listed. These should be drilled down to CSFs for respective departments like Finance, Marketing, Purchase, Stores, Production, Quality, Maintenance and HRD or Personnel. From these CSFs, performance measures required to address these CSFs should be culled out. The numeric figures against these performance measures can be classified as the Key Performance Indicators (KPIs). The process of firming up the above is usually done through workshops. This has to be completed before the processes to be configured on the ERP are drawn up. The important end users should be involved in evolving the process keeping ERP in mind. The KPIs derived from organizational goals and CSFs should be kept in mind.

The post implementation tasks are:

- Develop the new job descriptions and organization structure to suit the post ERP scenario.
- Determine the skill gap between existing jobs and envisioned jobs.
- Assessing training requirements, and create and implement a training plan.
- Develop and amend HR, financial and operational policies to suit the future ERP environment.
- Develop a plan for workforce logistic adjustment.

Then the major task is to monitor KPIs and take correct business decisions to improve them. Hence, the immediate task is to set attainable goals. Certain KPIs, though existing in the system, are better monitored and controlled after ERP System attains maturity. There will be resistance to change, but the management should be strong to continue implementation.

12. (a) What are the activities of ERP implementation life cycle ?
(b) What does one mean by 'Going live' in relation to ERP implementation?

Answer:

12. (a) ERP implementation project involves different phases which have definite activities as explained below:

1. ***Pre-evaluation screening –*** to search for perfect package which will be most suitable in terms of functional fit of the business process, skill set available and easiness to adopt.
2. ***Package evaluation –*** to understanding the performance of the business and do the cost benefit analysis.
3. ***Project Planning Phase –*** to make a tentative plan for implementation in terms of time, identification of person responsible for co-ordination of the implementation programmes, skill development and monitoring the progress.
4. ***Gap Analysis –*** to identify the gap between the existing system and future expectations from the ERP system so as to optimize the outcome from the implementation programme.
5. ***Re-engineering –*** to bring the necessary changes in the system in terms of physical system, hardware, mindset of the people, data flow and reporting.
6. ***Configuration –*** to install the necessary hardware, data base management system and configuration of the ERP system accordingly.
7. ***Testing –*** to test the system with test data set like entering data, validating them and generating reports for all modules and checking their correctness.
8. ***End user Training –*** to impart training to people from different functional areas who will be associated with operations and handling reports.
9. ***Going live –*** to finally switching over to new system with data migration, and running the system with live data of all functional areas.
10. ***Post – Implementation*** – to arrange for maintenance of the system in terms provision of technical expertise in cases of problems.

(b) **Going Live:** In this phase, the system is to be finally implemented in new environment with real life data set and to the satisfaction of the end-users. In ERP systems, the integration of all the modules is the critical part. The end-users must understanding the sequence of operations, how one module interact with the others and what are the restrictions in operation in terms of priority so as to establish proper checks at all levels in the process. The co-ordination among project members for different modules is very essential for smooth and successful implementation.

Post-implementation maintenance: Once the implementation is over, the services of vendor and the hired consultants will not be available. Trained in-house employees may have limited exposure to take care of all the problems just after implementation. Post implementation needs a different set of roles and skills to solve the problems in an integrated system. The training will never end. New functionality may be added which will invite different technical problems like enhancement of system, fresh configuration

for added integration features. Thus, this is a very critical phase. To reap the full benefit of ERP system, there should be arrangement for continuous training of employees and periodical review on how to enhance the advantage from the system.

13. (a) What is prototyping approaches to systems development? What are its advantages and shortcomings?

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

Answer:

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

Prototyping consists of following four steps:

1. **Identify Information System Requirements:** In traditional approach, the system requirements have to be identified before the development process start. However, under prototype, the process of determining them can be less formal and time-consuming than when performing traditional systems analysis.
2. **Develop the Initial Prototype:** In this step, the designers create an initial base model-for example, using fourth-general programming languages or CASE tools. The main goal of this stage is 'rapid development' and 'low cost'.
3. **Test and Revise:** After finishing the initial prototype, the designers first demonstrate the model to users for experiment. At the outset, users must be told that the prototype is incomplete and requires subsequent modifications based on their feedback. Thus, the designers ask users to record their likes and dislikes about the system and recommend changes. Using this feedback, the design team modifies the prototype as necessary and then resubmits the revised model to system user for reevaluation. Thus interactive process of modification and reevaluation continues until the users are satisfied-commonly, through four to six interactions.
4. **Obtain User Signoff of the Approved Prototype:** At the end of Step 3, users formally approve the final version of the prototype, which commits them to the current design and establishes a contractual obligation about what the system will, and will not do or provide.

Advantages of Prototyping

1. Prototyping requires intensive involvement by the system users. Therefore, it typically results in a better definition of the users' needs and requirements than does the traditional system development approach.

2. A very short time period (e.g., a week) is normally required to develop and start experimenting with a prototype. This short time period allows system users to immediately evaluate proposed system changes.
3. Since system users experiment with each version of the prototype through an interactive process, errors are hopefully detected and eliminated early in the developmental process. As a result, the information system ultimately implemented should be more reliable and less costly to develop than when the traditional systems development approach is employed.

Disadvantages of Prototyping

1. Prototyping can only be successful if the system users are willing to devote significant time in experimenting with the prototype and provide the system developers with change suggestions.
2. The interactive process of prototyping causes the prototype to be experimented with quite extensively. Because of this, the system developers are frequently tempted to minimize the testing and documentation process of the ultimately approved information system. Inadequate testing can make the approved system error-prone, and inadequate documentation make this system difficult to maintain.
3. Prototyping may cause behavioral problems with system users. These problems include dissatisfaction by users if system developers are unable to meet all user demands for improvements as well as dissatisfaction and impatience by user when they have to go through too many interactions of the prototype.

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

Components of the automated office and major functions thereof are:

(i) **Word processing**- It provides preparation of typed document in different ways, their storage, revision and printing.
(ii) **Electronic Mail-** It allows typed message to be sent to or received from any part of the world electronically.
(iii) **Voice Mail**- It facilitates spoken message to be sent to or received from any part of the world electronically.
(iv) **Facsimile-** It allows any typed or handwritten or printed documents to be sent to or received from any part of the world electronically.
(v) **Tele-conferencing**- It facilitates conferencing or meeting among persons located at different places.
(vi) **Personal computing**- It places computing decision support at workers' fingertips.
(vii) **Reprographics**– A combination of automated machines for providing multiplicities of documents like photocopies, scanners, laser printers etc.

14. (a) What is World Wide Web? How would you distinguish it from Internet?
(b) Explain the working principle of Electronic Data Interchange (EDI).
(c) What is a digital signature? How is it created and verified?

Answer:

14. (a) The World Wide Web or **www** as it is called is a concept based on the internet technology. It is a concept that provides the technology to navigate the vast resources available on the internet. The concepts of hypertext, internet and multimedia are integral to the concept of www. The word 'web' in the www signifies the ability to navigate through the multitude of computers and access texts, graphics, sound files etc. in a web-like fashion.

Internet is the network of hundreds or thousands of computers and computer networks worldwide, which are connected with each other, exchanging information. The network is not controlled by central authority or organisation. Instead of data going to a central computer and then to its destination with Internet, the data has many points to go from one computer to another, over a web of computers.
www is a concept while Internet is the physical aspect of it.

Electronic Data Interchange (EDI): EDI is the transmission of business information in standard format between computers of independent organizations. There is no need to change the database structure by the companies for implementation of EDI. However, EDI software is required to be developed for translating the format used by one organization to the format being used by another organizations. So EDI is computer-to-computer communication using a standard data format to exchange business information electronically between independent organizations.

(b) Working Principle of EDI – EDI is the electronic exchange of business documents such as invoices, purchase orders, shipping notices etc. EDI is a three step process:-

1. First of all, sender data is converted into standard format as defined by EDI translation software.
2. Data in standard format is transferred to the receiver using communication lines.
3. Finally, standard format data is converted according to the format of receiver data base files.

EDI consists of three components:

(i) Communication - To make EDI work, one needs communication software, translation software and access to standards. Communication software moves data from one point to another, flags the start and end of the document. Translation software helps the user to build a map and shows him how the data fields from his application corresponds to the elements of EDI standards. It also converts data back and forth between the application format and the EDI format.

(ii) Mapping - To build a map, the user first selects the EDI standard for the kind of data he wants to transmit. Usually the trading partner tells about the kind of standards to be used. Next, he edits out parts of the standards, which do not apply, to his application. Next, he imports a file that defines the fields in his application, and finally he makes the map to show where the data required by the EDI standards

is located in his application. Once the map is built, the translator will refer to it during EDI processing every time a transaction of that type is sent or received.

(iii) Profile - The last step is to write a partner profile that tells the system where to send each transaction and how to handle errors or exceptions. Whereas the user needs a unique map for every kind of documents he exchanges with a partner, he should only have to define partner information once.

(c) 'Digital signature' means authentication of any electronics record by a subscriber by means of an electronic method or procedure.

Digital signature is created by using a hash result which is unique to both the signed message and a given private key. For the hash result to be created there must be only negligible possibility that the same digital signature could be created by the combination of any other message or private key. Digital signature is verified by the process of checking the digital signature by reference to the original message and a given public key and determining whether the digital signature was created for that same message using the private key that corresponds to the referenced public key.

15. (a) What is E-Commerce? What are the components involved in it? What are the steps by which a transaction takes place in E-Commerce?

(b) What is DNS? Describe the forms of address for identifying the computers over the Internet.

Answer:

15. (a) E-Commerce is digitally enabled commercial transaction i.e. paperless exchange of business information by using electronic data interchange[EDI],e-mail, electronic bulletin board, electronic funds transfer, World Wide Web and other network based technologies.

The components involved in E-commerce are:

1. Customers
2. Suppliers
3. Service Provider
4. Channel partner (distributor)
5. Regulatory Authority

The following are the steps by which a transaction in E-Commerce takes place:

1. Consumer accesses a shopping mall and selects a shop for purchasing certain items.
2. Shopping mall serves the access to the merchant for a selected shop
3. Merchant system presents the home page to the consumer
4. Consumer selects the desired goods
5. Consumer interacts with the merchant system and makes the payment
6. Merchant system accesses his bank for authorization of the consumer payment
7. Authorization of payment by the bank
8. Merchant system informs the consumer that the payment is accepted and transaction is completed.
9. The consumer bank informs the consumer of the money transfer
10. Physical delivery of the items.

(b) DNS stands for Domain Name System. Actually it is hierarchical, distributed method of organizing the name space of the internet.

Different forms of address for identifying the computers over the internet are as follows:

1. **IP Address**: Internet Protocol Address is an unique address that computing devices use to identify itself and communicate with other devices in the Internet Protocol network. Any device connected to the IP network must have an unique IP address within its network. IP address consists of four sections separated by periods, for example 216.3.218.12

2. **Domain Name**: This is the name that identifies an Web site. Every domain name has a suffix that indicates which top level domain it belongs to. For Example:
   gov- Government agencies
   edu- Educational institutions
   org- Organizations (non profit)
   mil – Military
3. **URL** – Uniform Resource Locator is the global address of documents and other resources on the World Wide Web.