Paper 9 - Operations Management and Information System

Section –A

[Question no. 1 is Compulsory and any 4 from the rest]

1. Answer the following questions: [6x2]

(a) A workshop has 20 nos. of identical machines. From the failure pattern of the machines it is calculated that the expected time before failure is 3 months. It costs ₹200 to attend a failed machine and rectify the same. Compute the yearly cost of servicing the broken down machines.

(b) Name the core concepts of Total Quality Management?

(c) A shaft of 6000 mm in length requires machining on a lathe. If the spindle executes 3000 r.p.m. and the feed is 0.20 mm per revolution, how long does it take the cutter to pass down the entire length of the shaft?

(d) Discuss the advantages of Vertical Integration.

(e) What are the factors affecting the process planning?

(f) What is Risk Purchase?

Answer:

1.

(a) No. of repairs/machine/annum = 12/3 = 4.
Considering 20 machines and ₹200 to attend a failed machine, the yearly cost of servicing = 20 × 4 × ₹200 = ₹16,000.

(b) The three core concepts of Total Quality Management are
(i) Quality Control (QC)
(ii) Quality Assurance (QA)
(iii) Quality Management (QM).

(c) The number of revolution in passing 6000 mm = 6000 /0.20 = 30000
Since the spindle executes 3000 r.p.m., the time required =30000/3000 = 10 minutes.

(d) Advantages of vertical integration are:
(i) Can sometimes increase market share and allow the firm enter foreign markets more easily.
(ii) Can achieve savings in production cost and produce higher quality goods.
(iii) Can achieve more timely delivery.
(iv) Better utilization of all types of resources.

(e) Factors affecting process planning
- Volume (quantity) of production.
- Delivery dates for components or products.
- Accuracy and process capability of machines.
- The skill and expertise of manpower.
- Material specifications.
- Accuracy requirements of components or parts.

(f) Risk purchase is a protection provided to the buyer, in case the supplier fails to supply the contracted quantity and subsequently if the buyer purchases the goods at a price

higher than the contracted price from any other supplier, the extra amount thus paid for risk purchase will be recoverable from the defaulting supplier.

2. (a) The faculty in an engineering institute is planned to rise to strength of 50 staff members and then to remain at that level. The wastage of recruits depends upon their length of service and is as follows:

Year	1	2	3	4	5	6	7	8	9	10
Total %age who left upto the end of year	5	35	56	65	70	76	80	86	95	100

(i) Find the number of staff members to be recruited every year.

(ii) If there are seven posts of Head of Department for which, length of service is the only criterion of promotion, what will be the average length of service after which a new entrant should expect promotion? [6+4]

(b) What type of works are carried out during routine maintenance? [2]

Answer:

2. (a) Let us assume that the recruitment per year is 100. From above it is clear that the 100 who join in the first year will become zero in 10th year, the 100 who join in the 2nd year will (serve for 9 years and) become 5 at the end of the 10th tear and the 100 who join in the 3rd year will (serve for 8 years and) become 14 at the end of the 10th year and so on. Thus, when the equilibrium is attained, the distribution length of service of staff members will be as under:

Year	No. of staff members
0	100
1	95
2	65
3	44
4	35
5	30
6	24
7	20
8	14
9	5
10	0
Total	432

(i) Thus if 100 staff members are recruited every year, the total number of staff members after 10 years of service = 432.

To maintain a strength of 50, the number to be recruited every year = $\frac{100}{432} x 50 = 11.6$

It is assumed that those staff members who completed x years service but left before x+1 years' service, actually left immediately before completing x +1 years.

If it is assumed that they left immediately after completing x years' service, the total number will become 432 – 100 = 332 and 100 the required intake will be $= 50 \text{ x } \frac{100}{332} = 15$

In actual practice they may leave at any time in the year so that reasonable number of recruitments per year $= \frac{11.6+15}{2}$ =13.3 (approx).

(ii) If we recruit 13 persons every year then we want 7 seniors. Hence if we recruit 100 every year, we shall require $= \frac{7}{13} x100 = 54$ (approx.) seniors.

It can be seen that 54 seniors will be available if we promote them during 6th year of their service (0+5+14+20+24=63>54.

The promotion of a newly recruited staff member will be due after completing 5 years and before putting in 6 years of service.

(b) The types of work carried out during routine maintenance are lubrication, cleaning, periodic overhaul, tightening nuts & bolts. etc. Routine maintenance is emphasized to ensure that flows are not interrupted by downtime or malfunctioning equipment.

3. (a) A public transport system is experiencing the following number of breakdowns for months over the past 2 years in their new fleet of vehicles:

Number of breakdowns	**0**	**1**	**2**	**3**	**4**
Number of months this occurred	**2**	**6**	**8**	**5**	**1**

Each breakdown costs the firm an average of ₹2800. For a cost of ₹1500 per month, preventive maintenance can be carried out to limit the breakdowns to an average of one per month. Which policy is suitable for the firm? [5]

(b) Write a note on Problem Formulation under Linear Programming. [3]

(c) Define 5 S's concept in Quality Management. List the five primary 5S phases [4]

Answer:

3. (a) Converting the frequencies to a probability distribution and determining the expected cost/month of breakdowns we get:

No. of breakdowns	Frequency in months	Frequency in per cent	Expected Value
(A)	(B)	(C)	(D)=(C × A)
0	2	2/22 = 0.091	0
1	6	6/22 = 0.273	0.273
2	8	8/22 = 0.364	0.728
3	5	5/22 = 0.227	0.681
4	1	1/22 = 0.045	0.18
Total	22		1.862

Expected Breakdown cost per month: =1.862 × ₹2800 = ₹5214

Preventive maintenance cost per month:

Average cost of one breakdown/month = ₹2800

Maintenance contract cost/month = ₹1500

Total = ₹ (2800 + 1500) = ₹ 4300.

Thus, preventive maintenance policy is suitable for the firm.

(b) Problem formulation refers to translating the real life problem into a format of mathematical equalities and inequalities that abstracts all the essential elements of the problem. There are three parts of the formation (i) Objective function (ii) A set of constraints and (iii) Non-negativity restriction.

LP problem has got three points:

(i) Objective function: This describes the object of the management in precise and clear terms in quantitative form. To identify the decision variables and assume optimal values.

(ii) A set of constraints: These are the limitations of the management expressed in quantitative form.

(iii) Non-negative restriction: This restriction prescribes that the decision variables should only be zero or positive.

(c) 5S is the name of a workplace organization method that uses a list of five Japanese words: seiri, seiton, seiso, seiketsu and shitsuke. The list describes how to organize a work space for efficiency and effectiveness.

There are five primary 5S phases: sorting, straightening, systematic cleaning, standardizing and sustaining.

4. (a) A manager has to decide about the number of machines to be purchased. He has three options i.e. purchasing one, or two, or three machines. The data are given below:

Number of machines	Annual Fixed cost (₹)	Corresponding range of output (units)
1	10,000	0 to 400
2	12,000	401 to 700
3	20,000	701 to 1000

Variable cost is ₹ 20 and revenue is ₹ 40 per unit.

(i) Determine the break-even point for each range.

(ii) If projected demand is between 600 and 750 units, how many machines should the manager purchase? [3+4]

(b) Write a short note on Computer Aided Design. [5]

Answer:

4. (a) Let Q = Break-even Point, FC = Fixed Cost, R= Revenue per unit and VC= Variable cost per unit.

$$\text{Then } Q = \frac{FC}{(R - VC)}$$

(i) Let Q1 be the break-even point for one machine option, Q2 for two machine option and Q3 for three machine option.

$$\text{Then } Q1 = \frac{10000}{(40-20)} = \frac{10000}{20} = 500 \text{ units.}$$

$$Q2 = \frac{12000}{(40-20)} = \frac{12000}{20} = 600 \text{ units.}$$

$$Q3 = \frac{20000}{(40-20)} = \frac{20000}{20} = 1000 \text{ units.}$$

(ii) The break-even point for single machine option (i.e. 500 units) is not feasible because the demand exceeds the range of volume that can be produced with one machine (i.e. 0 to 400 units).

Also, the break-even point for 3 machines is 1000 units which is more than the upper limit of projected demand 600 to 750 units and hence not feasible. For two machines option the break-even volume is 600 units and volume range is 401 to 700.

Hence, the demand of 600 can be met with two machines option which is break-even. If the manager wants to produce 750 units with 3 machines, there will be loss because the break-even volume with three machines is 1000 units.

Hence, the manager would choose 2 machines option.

(b) Computers are increasingly used for product design. Computer Aided Design uses computer graphics for product design. The designers can modify an existing design or create a new design on a computer monitor screen by means of a keyboard or a joy stick. It can be rotated to provide the designer different views of the products, it can be split apart to have a view of the inside and a position of the product can be enlarged for closer view. The printed version of the completed design can be taken and also the design can be stored electronically. A number of products such as printed circuit boards, transformers, automobile parts, aircraft parts etc. can be designed using CAD.

CAD increases the productivity of designers from 3 to 10 times and preparing mechanical drawings of product or parts and modifying them frequently becomes easier. Also a data base can be created for manufacturing which can supply required information on product geometry and dimensions, tolerances, material specifications etc. Also, some CAD systems facilitate engineering and cost analysis on proposed designs, for example, calculation of volume and weight and also stress analysis can be done using CAD systems. It is possible to generate a number of alternative designs using computer aided design systems and identify the best alternative which meets the designer's criteria.

5. (a) Draw the network for the following activities and find critical path and total duration of project:

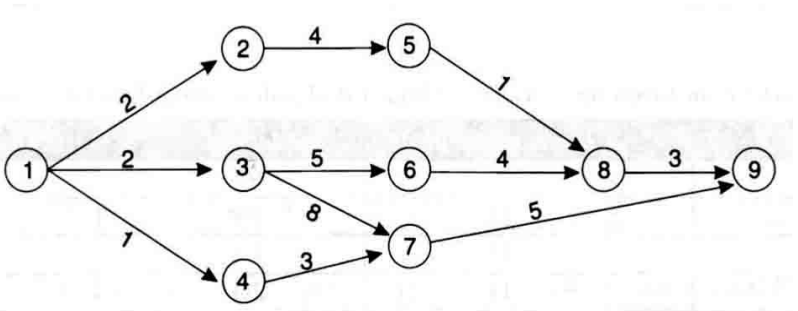
Activity	Duration (months)	Activity	Duration (months)
1-2	**2**	**4-7**	**3**
1-3	**2**	**5-8**	**1**
1-4	**1**	**6-8**	**4**
2-5	**4**	**7-9**	**5**
3-6	**5**	**8-9**	**3**
3-7	**8**		

[8]

(b) What are the steps involved in Work Sampling? [4]

Answer:

5. (a)



Paths	1-2-5-8-9	1-3-6-8-9	1-3-7-9	1-4-7-9
Duration	2+4+1+3 = 10	2 + 5 + 4 + 3 =14	2+8+5 = 15	1+3+5 = 9
The ***critical path is* 1-3-7-9.** Its duration is 15 months.				

(b) The work sampling study consists of essentially the following steps:

(i) Determine the objective of the study, including definitions of the states of activity to be observed.

(ii) Plan the sampling procedure including:
- An estimate of the percentage of time being devoted to each phase of the activity.
- The setting of accuracy limits.
- An estimation of the number of observations required.
- The selection of the length of the study period and the programming of the number of readings over this period.
- The establishment of the mechanics of making the observations, the route to follow and the recording of data.

(iii) Collect the data as planned.
(iv) Process the data and present the results.

6. (a) What are the various factors to be considered for deciding on automation alternatives?[6]
(b) State the benefits for the individual by adopting quality circles. [6]

Answer:

6. (a) Managers, while considering automation decisions, must evaluate automation alternatives. Economic analysis is an important if not a predominant factor in choosing among automation alternatives. The various factors to be considered are:

(i) Economic factors: The focus is on cashflows, annual fixed costs, variable cost per unit, average production cost per unit or total annual production costs at the forecasted production levels. But the main intention is to determine the direct impact of automation on profitability. Break-even-analysis and financial analysis are used for this purpose.

(ii) Effect on market share: Some automation alternatives may require product redesign or product specialisation which may affect sales. Even if some alternatives permit more product variety and greater customer appeal, the net effect of such changes on market share is difficult to assess.

(iii) Effect on product quality: Impact of automation alternatives on product quality is difficult to measure directly even though scrap rates, market share changes and production costs may reflect the effect of changes in product quality resulting from automation alternatives.

(iv) Effect on manufacturing flexibility: Measures of product flexibility and volume flexibility are difficult to develop even though cost of machine change-overs, overtime labour costs and market share changes can be used as measures of the effect of automation alternatives on manufacturing flexibility.

(v) Effect on labour relations: The number of workers to be laid off, the amount of training and retraining needed and the availability of skilled workers required to operate automated equipments are factors affecting the choice of automation alternatives

(vi) The amount of time required for implementation: Different automation alternatives may require different time durations for implementation because of differences in technology, availability of competent personnel and different kinds of changes in the rest of production system caused by the automation alternatives.

(vii) Effect of automation implementation on ongoing production: Even while automation projects are being implemented, regular production must go on because delivery of products to customers cannot be postponed. The extent to which the ongoing production gets affected depends on the type of automation alternatives.

(viii) Amount of capital investment required: Availability of capital for inventory in automation project is an important factor to be considered because almost all

automation alternatives are highly capital intensive. This factor can be a predominant consideration in automation decisions.

(b) **Benefits for the Individual**

(i) **Personality Development.** For doing a job, everyone needs some kind of help from others, during such help exchange of ideas are involved. This leads to the personality development of an individual as he is sure to receive good ideas of others.

(ii) **Mutual Development.** Quality circle is a group activity, as such in a group every individual, besides, developing self also help in the development of others, this leads to development of the whole group which in turn leads to the development of society and nation.

(iii) **Job Satisfaction.** It is a well-known fact that an individual or a group feels satisfied if the ideas given by them are implemented.

This is also a human tendency that once encouraged every person tries to do more and more constructive work in future. This gives job satisfaction. Moreover a stage comes when salary, allowances post, facility do not encourage an individual if his ideas are not given due importance.

(iv) **Problem Solving Capability.** In the absence of QC, every problem has to be solved by management. It is quite possible that top management may not completely understand the problems of a particular work area.

QC member are well in touch with the problems of their work area and hence can find best solution of such problems earlier.

This way the management can look into other work and problem solving capability in QC member are enhanced.

(v) **Togetherness.** QC is a group activity and this way it creates an atmosphere where an individual starts thinking about we rather than I, this reduces and eliminates the enmity between workers and then the problems can be solved easily.

(vi) **Better Human Relationship.** QC leads to better relationship because if we work together, we are sure to develop better relationship with others.

(vii) **Exchange of Good Thoughts.** When the better human relations are established we can exchange our thoughts in a better manner and without any hesitation.

(viii) **Orating Capability (Stage openings).** Many times an individual may not explain his ideas due to hesitation or shyness, after working in QC, a member can get rid off such problems and can express themselves in a better manner.

Section – B

Question No. 7 is compulsory and any 4 from the rest

7. (a) Define Data Mart.
(b) What is Gap Analysis?
(c) What do you mean by Modularity?
(d) What do you mean by final acceptance testing? [4 x2]

Answer:

7. (a) Data Mart is a simple form of data warehousing. In other words. It is a scaled-down version of data warehousing. Data marts of a company are generally created with specific objectives. It may be function specific. The advantages of creation of data mart are low cost and less time requirement. Data marts are created with a specific focus.

(b) Gap Analysis is a pre-requirement for successful ERP implementation in order to identify the gap between the existing system and future expectations from the ERP system. It is important in ERP implementation so as to take appropriate measures to improve upon the existing systems and eliminate or minimize the gap. This will enable optimization of the outcome from the ERP implementation programme.

(c) A module is a manageable unit containing data and instructions to perform a well-defined task. Modularity is measured by two parameters: Cohesion and Coupling. Cohesion refers to the manner in which elements within a module are linked. Coupling is a measure of the interconnection between modules. In a good modular design, cohesion will be high and coupling will be low.

(d) Final acceptance testing is conducted when the system is just ready for implementation. During this testing, it is ensured that the new system satisfies the quality standards adopted by the business and the system satisfies the users.

Thus final acceptance testing has following major parts:

- Quality Assurance Testing which ensures that the new system satisfies the prescribed quality standards.
- User Acceptance Testing which are of two types.
- Alpha Testing means the system testing which is often performed by the users within the organization.
- Beta testing is the second stage, generally performed by external users such as by experts, data entry operators.

8. (a) ABC Ltd. is considering two options to acquire software for computerizing one of its important functional areas. The options are:
(i) Buying the software package available in the market
(ii) Engaging software industries to design the software [3+3]
(b) Name the different stages of the System Development Life Cycle. [2]

Answer:

8. (a)

The relative advantages and disadvantages of the two options are enumerated in the following table:

	Advantages	Disadvantages
Buying readymade software	(i) Can be seen and tested.	(i) May not meet requirements fully.
	(ii) Will have fewer bugs	(ii) Enhancement/modifications may be expensive and time consuming.

package	(iii) May be less costly	(iii) Requires development, testing and implementation time.
	(iv) Documentation/support facilities.	
Developed by outside software firm	(i) Better control over schedule and cost.	(i) Difficult to negotiate on effort and time required.
	(ii) Does not affect day-to-day operations due to development work.	(ii) Difficult to implement without adequate technical knowledge of the software.
	(iii) Ready skills on chosen hardware or software platforms.	(iii) Difficult to maintain after implementation.
	(iv) Advantage of core competencies.	(iv) Unfamiliarity of the outside party about the business environment may hamper quality
		(v) Maintenance support cost.

(b) System development involves seven stages. These stages together is called System Development Life Cycle (SLDC). They are:
(i) System Proposal
(ii) System Study
(iii) System design
(iv) Program Development
(v) System Implementation
(vi) System Evaluation & Review
(vii) System Maintenance

9. (a) Briefly explain the different models of DBMS? [6]
(b) Define Normalization. [2]

Answer:

9. (a) Different models of DBMS:
(i) Hierarchical database
(ii) Network database
(iii) Relational database

(i) Main features of hierarchical database structure are:
- Parent record will have some child records (all linked with it).
- A record becomes a child when it corresponds to its higher level record.
- The same record may be a parent record in relation to its lower level (child record).
- A child has one parent but a parent may have more than one child.
- Between two consecutive levels of records, the relation is unique.
- It cannot represent "many to many" relationship.

(ii) In network database, each mode may have convection with many other modes showing the structure to be similar to the network. Modes are connected in a multi-dimensional manner. The relation among the modes is not as simple as in the hierarchical model. This model has much flexibility and is suitable for a complex relation among the modes. The main advantage of this model is that the database

can accommodate a number of inter-related records with relational path to be a network standard. The complexity of the structure is its problem to have wide acceptance.

(iii) Relational Database (RDBMS): It is the most widely used database model. Under this model, tables are formed with several closely related data elements and relation is established among the tables. No two rows in table can be identical. Relationship between two tables is established at column levels and the related data elements from two tables from different rows can be linked. The concept is very popular in the sense it is almost similar to conventional file system. The relational database software has a good provision for linking relationship among different tables and establishing security features for maintaining integrity of data.

(b) Normalization is a process of organizing data in a database. The fundamental principle of normalization is that the same data should not be stored in more than one place. The basic aim of normalization in data structure is to eliminate redundancy and inconsistent dependency. The design of database with greater level on normalization provides better efficiency.

10. Write short notes on **[4x2]**
(a) Knowledge Management
(b) Decision Hierarchy

Answer:

10. (a) Knowledge management (KM) comprises of a range of strategies and practices used in an organization to identify, create, represent, distribute and enable adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizations as processes or practices.

The main function of knowledge management in corporate world involves the process development of minds of decision makers through continuous flow of right kind of information and their critical evaluation.

The knowledge management has demonstrated a good account of success in deriving effective business solution. This tool is in developing process and its potential is enormous in guiding the model management in making decisions relating to market, product, and technology and so on. Knowledge base is assimilation of best experience and business process. It is a collection of effective business solutions history and comprehensive corporate data base.

Steps involved are:

(i) Creating the information database and constant updates.
(ii) Creating technological infrastructure.
(iii) Developing analytical skill.
(iv) Continuous feedback system.
(v) Creating culture of sharing – exchange of information.
(vi) Capturing knowledge (analytical information and expert opinion).

(b) Decision making process follows a well established hierarchy. Different levels of management are involved in different types of decisions. This type of decision depends on the level of responsibility and their controlling activities. Decision may be of different

kinds. Decision hierarchy explains that lower level management takes decision on operation, whereas middle level on tactical and top management on business strategy.
Top Management- Top management is concerned with strategic decisions like diversification, technology acquisition, new market exploration, strategic business alliance, takeover, merger etc.

Middle Level- Middle level management is generally involved in tactical decision making with the help of performance analysis, budget variance analysis, devising better productivity mechanism and control etc.

Strategic decision making is concerned with the issues relating to long-term effect on the business growth and prospect of the organization as a whole and involves both internal and external factors.

Tactical decisions are concerned with issues having short-term effect on the business. Primary aim of this type of decision is to effective use of resources, remove any imbalance among different factors of production and improve productivity of factors of production.

Operational decisions are related to the effective use of resources acquired out of tactical decisions and aims of these decisions are to have effective control of the use of resources in day-to-day business activities.

11. (a) What are the salient features of LAN? [4]
(b) What is an ERP package? What are the reasons for accepting ERP system as an ideal system for replacing the old business system? [1+3]

Answer:

11. (a) Salient features of LAN:
(i) Computing equipments are spread over small geographical area.
(ii) Communication channels between the machines are private.
(iii) Server is powerful microcomputer or minicomputer or mainframe.
(iv) LAN file server is a repository of variety of software and data file for the network.
(v) Relatively high capacity communication channels are used.
(vi) More reliable in communication.
(vii) Cost of interfacing is usually low.

Each device in LAN can work independent of network.

(b) ERP package is a software with the help of Database Management System integrating information related to all functional areas. Globally, acceptance of ERP system is in great demand. Industry analysts are forecasting growth rate of more than 30% in next five years. The reasons for accepting ERP system replacing their old business system are as follows:
(i) Improved business performance through optimum resource utilization
(ii) Reduction in manufacturing cycle time by integrated planning process.
(iii) Better support customers in fast changing in market conditions
(iv) Better cost control mechanism by way of accurate costing system
(v) Enhanced efficiency in control through feedback information and online access to accurate information
(vi) Establishment of decision support system etc.

12. (a) What is electronic cash? What are the steps involved in transferring money between parties? [1+4]
(b) Write short note on Search Engines [3]

Answer:

12. (a) Electronic cash or e-cash or digital money is to provide the means to transfer money between parties in the network.

Steps involved in transferring money between parties are:

(i) Consumer requests his bank to transfer money to e-mint to obtain electronic cash.
(ii) Consumer bank transfers money from customer account to e-mint.
(iii) E-mint sends the cash to consumer. Consumer sends the electronic cash in a hard drive or a small card.
(iv) Consumer selects the goods and transfers the e-cash to merchant.
(v) The merchant provides the goods to the customer.
(vi) The merchant sends the electronic cash to his bank.
(vii) The bank redeems the money from the e-mint.
(viii) E-mint transfers the money to the merchant's bank account.

(b) Search Engines are websites maintaining databases of websites and their contents. When a user wants to locate particular information, the task is done through a search engine. Searching is done by index for the database. The web search engine on receiving request from an user, searches the relevant information from the database and submits the information for the user. There are many search engines available on the web.

Some popular search engine are www.google.com, www.rediffmail.com etc. Registration on a search engine is free. Search engine is viewed by millions of people every day. They have become a strong media for advertisement. Search Engine encourages viewers by providing free service.