

**INTERMEDIATE EXAMINATION
GROUP II
(SYLLABUS 2012)**

**SUGGESTED ANSWERS TO QUESTIONS
DECEMBER 2016**

Paper - 9: OPERATION MANAGEMENT AND INFORMATION SYSTEM

Time Allowed : 3 Hours

Full Marks : 100

The figures in the margin on the right side indicate full marks.

This paper contains 3 Sections.

All Sections are compulsory, subject to instruction provided below each Section.

All workings must form part of your answer.

Assumptions, if any, must be clearly indicated.

SECTION – A

There are two questions in this Section. Answer both the questions which are compulsory.

1. Answer all the questions: 2×10=20
- (a) 'Computers have entered the maintenance function in a big way.'
List two important areas in maintenance where computer assistance is taken.
 - (b) Define 'critical path'.
 - (c) After forecasting human resource needs, it is logical to _____ how these needs can be _____.
 - (d) List categories of processes in a production system.
 - (e) List causes of low productivity in the Indian context.
 - (f) State whether 'True' or 'False':
 - (i) An individual having lower capabilities than his / her job requirements should be transferred to a less demanding job.
 - (ii) The change in technology has no impact on the established methods, procedures and processes in an industry.
 - (g) 'Information can broadly be divided into two different types.' List such types.
 - (h) With reference to DBMS, illustrate 'privileged software' in one or two sentences.
 - (i) List the three levels of management in the order of hierarchy.
 - (j) List basic characteristics of Business Process Re-engineering.

Answer:

- (a) Important areas in maintenance where computer assistance is taken are:
- (i) Scheduling maintenance projects;
 - (ii) Maintenance cost reports by production department, cost category and other classifications;
 - (iii) Inventory status reports for maintenance part and supplies;
 - (iv) Parts failure data; and
 - (v) Operations analysis studies which may include computer simulation, waiting lines, and other analytical programmes.
- (b) A critical path is a chain of sequential activities beginning with the project start and ending with its completion. Several or many path may exist through the network. Work may proceed on many independent paths concurrently, but, of course, work

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may proceed on an activity only after all the necessary predecessor activities in its path have been completed. All activities, hence all paths, must be completed before the project is finished.

The path through the network that has the longest expected completion time and is expected to determine the completion date of the project is called the critical path.

(c) Determine, met.

(d) Basically, processes can be categorised as:

- (i) Conversion processes, i.e., converting the raw materials into finished products (for example, converting iron ore into iron and then to steel). The conversion processes could be metallurgical or chemical or manufacturing or construction processes.
- (ii) Manufacturing processes can be categorised into (a) Forming processes, (b) Machining processes and (c) Assembly processes.
- (iii) Testing processes which involve inspection and testing of products (sometimes considered as part of the manufacturing processes)

(e) In the Indian context, the causes of low productivity have their origin in two distinct sources. The first category consists of the exogenous or external factors like shortages of essential inputs-power, raw materials, transport facilities etc. - over which the management of an enterprise has little or no control. The second basket contains the endogenous or internal factors mainly in the form of system deficiencies preventing the optimum utilisation of resources.

(f) (i) TRUE, (ii) FALSE

(g) Internal Information and External Information.

(h) We can apply security controls to the DBMS software. For example, only the DBA's staff may be allowed to use certain privileged software, such as the software for creating new accounts.

(i) The three levels of management in the order of hierarchy are Top Management, Middle Management and Operational Management.

(j) Some of Basic characteristics of BPR are:

- View business as a set of customer (both internal and external) oriented processes rather than a set of departmental functions.
- Processes must have clear cut ownership.
- Non value adding activities within a process should be eliminated.
- Gather information only once at the point of origin.

2. Match List A with List B:

1×5=5

List A	List B
(a) Work Study	(i) To make the hardware work
(b) Product Life Cycle	(ii) Improved work flow
(c) Software	(iii) Correcting programming language errors
(d) Economies of Scale	(iv) Introduction, growth, maturity and decline
(e) Debugging	(v) Reduces overall costs of operation

Answer:

List A is matched with List B. Table is correctly re-drawn below:

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List A	List B
a) Work Study	ii) Improved work flow
b) Product Life Cycle	iv) Introduction, growth, maturity and decline.
c) Software	i) To make the hardware work
d) Economies of Scale	v) Reduces overall costs of operation
e) Debugging	iii) Correcting programming language errors

Section B

There are four questions in this Section. Answer any three questions.

15×3=45

1. (a) Calculate the break-even point for the following:

Production Manager of a unit wants to know, from what quantity he can use automatic machine against semi-automatic machine. 7

Data	Automatic	Semi-automatic
Time for the job	2 minutes	5 minutes
Set-up time	2 hours	1.5 hours
Cost per hour	₹ 20	₹ 12

(b) Describe the areas of Production Planning and Control. 8

Answer:

(a) Let x be the break-even quantity between automatic and semi-automatic machines. This means, for volume of output x , the total cost of manufacture is the same on both automatic and semi-automatic machines.

For quantity = x units

Total manufacturing cost of automatic machines = ₹ $(2.0+2x/60) \times 20$

Total manufacturing cost of semi-automatic machines = ₹ $(1.5+5x/60) \times 12$

If ' x ' is the break-even quantity, then

$$(2.0+2x/60) \times 20 = (1.5+5x/60) \times 12$$

$$\text{Or, } 40 + 2x/3 = 18 + x$$

$$\text{Or, } x - 2x/3 = 40 - 18 = 22$$

$$\text{Or, } x/3 = 22$$

$$\text{Or, } x = 66 \text{ units.}$$

Hence for quantity upto 65, a semi-automatic machine will be cheaper. For quantity 66, both semiautomatic and automatic machines are equally costly. For quantity more than 66, automatic machine becomes cheaper than semi-automatic machine.

(b) Production Planning and Control encompasses the following areas:

(i) **Materials:** Planning for procurement of raw materials, components and spare parts in the right quantities and specifications at the right time from the right source at the right price. Purchasing, storage, inventory control, standardisation, variety reduction, value analysis and inspection are the other activities associated with materials.

(ii) **Methods:** Choosing the best method of processing from several alternatives. It also includes determining the best sequence of operations (process plans) and planning for tooling, jigs and fixtures etc.

(iii) **Machines and Equipments:** Manufacturing methods are related to production facilities available in the production system. It involves facilities planning, capacity planning, allocation and utilization of plant and equipments, machines etc.

It also involves equipments replacement policy, maintenance policy and maintenance schedules, tools manufacture and maintenance of tools etc.

(iv) **Manpower:** Planning for man power (labour, supervisory and managerial levels) having appropriate skills and expertise.

(v) **Routing:** Determining the flow of work, material handling in the plant, and

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sequence of operations or processing steps. This is related to considerations of appropriate shop layout and plant layout, temporary storage locations for raw materials, components and semi finished goods, and of materials handling system.

- (vi) **Estimating:** Establishing operation times leading to fixation of performance standards both for workers and machines.
- (vii) **Loading and Scheduling:** Machine loading is allocation of jobs to machines in conjunction with routing and with due consideration for capacity of machines and priority for jobs in order to utilize the machines to the maximum possible extent. Scheduling ensures that parts, sub assemblies and finished products are completed as per required delivery dates. It provides a time table of manufacturing activities. It ensures balanced load on all work centres and ensures even flow of work through the manufacturing facilities.
- (viii) **Dispatching:** This is concerned with the execution of the planning functions. It gives necessary authority to start a particular work which has already been planned under routing and scheduling functions. Dispatching is release of orders and instructions for the starting of production in accordance with the route sheets and schedule charts.
- (ix) **Expediting:** Means chasing, follow up or progressing which is done after dispatching function. It keeps a close liaison with scheduling in order to provide an efficient feedback and prompt review of targets and schedules.
- (x) **Inspection:** This function is related to maintenance of quality in production and of evaluating the efficiency of the processes, methods and labour so that improvements can be made to achieve the quality standards set by product design.
- (xi) **Evaluating:** The objective of evaluation is to improve performance. Performance of machines, processes and labour is evaluated to improve the same.
- (xii) **Cost Control:** Manufacturing cost is controlled by wastage reduction, value analysis, inventory control and efficient utilization of all resources.

2. (a) The demand function of a firm is $q = 200 - 10p$ and the average cost function is $AC = 10 + 25q$.
If the firm's objective is to maximise profit, what will be its profit maximising output? 6
- (b) Write down the formula for the following which are used for measuring maintenance effectiveness: 2×2=4
- (i) Down-time index (as a percentage); and
 - (ii) Maintenance cost index as a percentage.
- (c) Expand the following: 1×5=5
- (i) DFM (ii) TPM (iii) RA (iv) TQC (v) VAM

Answer:

- (a) Here the equation of the demand curve is —

$$Q = 200 - 10p$$

$$\text{Or, } 10p = 200 - q$$

$$\text{Or, } p = (200 - q)/10 = 20 - q/10$$

$$\text{So, total revenue } R = pq = 20q - q^2/10$$

$$\text{Marginal revenue (MR)} = (dR)/(dq) = 20 - q/5$$

$$\text{Again, } AC = 10 + 25q$$

$$\text{Total cost (C)} = AC \times q = 10q + 25q^2$$

$$\text{Marginal cost (dC)/(dq)} = 10 + 50q$$

Now, the first order condition for profit maximization requires, $MR = MC$.

(2 marks)

$$20 - q/5 = 10 + 50q$$

$$\text{Or, } 20 - 10 = 50q + q/5$$

$$\text{Or, } 10 = 50q + q/5$$

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$$\frac{250q+q}{5} = 10$$

Or,

$$50 = 250q + q$$

$$\text{Or, } 251q = 50$$

$$\text{Or } q = 50/251$$

Hence, to get maximum profit, the firm will produce 50/251 units of output

[Note - In this question the average cost function is $AC = 10 + 25q$, which gives demand q in fraction

If in the above question if the average cost function may be given as $AC = 10 + q/25$, then the solution of the above problem will be as follows

Here the equation of the demand curve is

$$q = 200 - 10p$$

$$\text{or, } 10p = 200 - q$$

$$\text{or, } p = (200 - q)/10 = 20 - q/10$$

$$\text{So, total revenue (R) = } pq = 20q - q^2/10$$

$$\text{Marginal revenue (MR) = } (dR) / (dq) = 20 - q/5$$

$$\text{Again, } AC = 10 + q/25$$

$$\text{Total cost (C) - } AC \times q = 10q + q^2/25$$

$$\text{Marginal cost (dC) / (dq) = } 10 + 2q/25$$

Now, the first order condition for profit maximization requires, $MR = MC$.

$$20 - q/5 = 10 + 2q/25$$

$$\text{Or, } q/5 + 2q/25 = 20 - 10$$

$$\text{Or, } 7q/25 = 10$$

$$\text{Or, } q = (10 \times 25)/7 = 250/7$$

The second order condition requires that slope of $MC >$ slope of MR .

$$\text{Now, slope of } MR = [d(MR)] / (dq) = -1/5 < 0$$

$$\text{and slope of } MC = [d(MC)] / (dq) = 2/25 < 0$$

So the second order condition is fulfilled.

Hence, to get maximum profit, the firm will produce 250/7 units of output.]

(b)

(i) Down time index (as a percentage) —

$$\frac{(\text{Down time per week})}{(\text{Available machine hours per week})} \times 100$$

(ii) Maintenance cost index (as a percentage) —

$$\frac{(\text{Annual Maintenance Cost})}{(\text{Cost of Production})} \times 100$$

(c)

Abbreviation	Expansion
DFM	Design for Manufacturing
TPM	Total Productive Maintenance
RA	Relaxation Allowance
TQC	Total Quality Control
VAM	Vogel's Approximation Method

- 3. (a) List the information to be collected before scheduling maintenance activities. 8**
(b) Compute the productivity per machine hour with the following data. Also draw your

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interpretation.

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Month	No. of machines employed	Working hours	Production units
July	390	210	95,000
August	540	170	1,00,000
September	570	230	1,30,000

Answer:

(a) The following information should be collected before scheduling maintenance activities:

- (i) Manpower (maintenance crew) available.
- (ii) Pending maintenance work (in terms of man hours backlog).
- (iii) Availability of machine or equipment for preventive maintenance service.
- (iv) Availability of proper tools, handling equipments, consumables, spare parts etc.
- (v) Availability special maintenance equipments if any, special fixtures and tools, cranes, etc.
- (vi) Whether additional manpower is available at outside sources to be hired when needed.
- (vii) When to start the maintenance work and when it should be completed,
- (viii) Previous maintenance history records or charts.

(b)

Month	No. of machines employed	Working hours	Machine hours	Production units
July	390	210	81,900	95,000
August	540	170	91,800	1,00,000
September	570	230	1,31,100	1,30,000

P = Productivity per machine hour

= Number of units produced /Machine hours

For July P = 95,000/81,900 = 1.160

August P = 100,000/91,800 = 1.089

September P = 130,000 /131,100 = 0.992

Interpretation: Though the total production in number of units is increasing, the productivity is declining.

4. (a) List the objectives of scheduling in an organisation. 5

(b) Reddy Transport Company (RTC) has a fleet of 50 trucks. The past data on the breakdown of the trucks show the following probability distribution (for a new truck as well as for one which has been repaired after a breakdown). 10

Months after Maintenance	Probability of Breakdown
1	0.10
2	0.20
3	0.30
4	0.40

Each breakdown costs ₹ 3,000 on an average, which includes cost of time lost and cost of materials and manpower.

The manager of RTC knows the importance of preventive maintenance. He estimates the costs of the preventive maintenance to be ₹500 per such preventive action.

What should be the appropriate maintenance policy in terms of the mix of preventive and breakdown maintenance?

Answer:

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(a) Objectives of Scheduling

- (i) To prevent unbalanced use of time among departments and work centres or to evenly load all machines
- (ii) To utilise machines and labour in such a way that the output is produced within the established lead time so as to
 - (a) deliver the products/services in time and
 - (b) complete production in the shortest cycle time possible at minimum total cost of production.
- (iii) To reduce idle time of labour and machines, which might be caused due to waiting for materials, waiting for movement, waiting for inspection and waiting for want of work.
- (iv) To fix up delivery dates for various manufacturing activities and for the finished products.
- (v) To increase the efficiency of production or productivity.

(b) First, let us compute the cost of a totally breakdown maintenance policy. The expected number of months between failures

$$= 0.1 (1) + 0.2 (2) + 0.3 (3) + 0.4 (4) = 3.0$$

Cost per month of totally breakdown maintenance policy

$$= \frac{(\text{No. of trucks})(\text{Cost per breakdown})}{(\text{Expected number of months between failures})} = \frac{(50)(\text{₹}3000)}{(3.0)} = \text{₹ } 50,000.$$

Now let us compute the costs of following different periodicities of preventive maintenance.

(i) Preventive maintenance (PM) period one month

No. of breakdowns within the period of one month:

$$B_1 = (50) \times (0.1) = 5$$

$$\text{Cost of breakdown} = 5 \times \text{₹ } 3000 = \text{₹ } 15,000$$

$$\text{Cost of preventive maintenance} = \text{₹ } 500 \times 50 = \text{₹ } 25,000$$

$$\text{Total Cost during the PM period} = \text{₹ } 40,000$$

$$\text{Therefore, cost per month for this policy is} = \text{₹ } 40,000 \div 1 = \text{₹ } 40,000$$

(ii) Preventive maintenance (PM) period two months

No. of breakdowns within 2 months:

$$B_2 = (50) \times (0.1 + 0.2) + (50) \times (0.1) \times (0.1) = 15.5$$

$$\text{Cost of breakdown} = (15.5) \times \text{₹ } 3000 = \text{₹ } 46,500$$

$$\text{Cost of prev. maintenance} = \text{₹ } 500 \times 50 = \text{₹ } 25,000$$

$$\text{Total cost during the PM period} = \text{₹ } 71,500$$

Therefore, cost per month for this policy:

$$\text{₹ } 71,500 \div 2 \text{ months} = \text{₹ } 35,750$$

(iii) Preventive maintenance period 3 months

No. of breakdowns within 3 months:

$$B_3 = (50) \times (0.1 + 0.2 + 0.3) + (50 \times 0.1) (0.1 + 0.2) + (50 \times 0.1 \times 0.1) (0.1) \\ = 30 + 1.5 + 0.05 = 31.55$$

$$\text{Cost of breakdown} = 31.55 \times \text{₹ } 3000 = \text{₹ } 94,650$$

$$\text{Cost of preventive maintenance} = 50 \times \text{₹ } 500 = \text{₹ } 25,000$$

$$\text{Total} = \text{₹ } 1,19,650$$

Therefore, cost per month for this policy

$$= \text{₹ } 1,19,650 \div 3 \text{ months} = \text{₹ } 39,883.33$$

(iv) Preventive maintenance period 4 months

No. of breakdowns within 4 months

$$B_4 = [(50) \times (1.0)] + [(50) \times (0.1) \times (0.1 + 0.2 + 0.3) + (50 \times 0.1 \times 0.1) \times (0.1 + 0.2) + (50 \times$$

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$$0.1 \times 0.1 \times 0.1) \times (0.1) + (50 \times 0.1 \times 0.2) \times (0.1)] + [(50 \times 0.2) \times (0.1 + 0.2) + (50 \times 0.2 \times 0.1) \times (0.1)] + [(50 \times 0.3 \times (0.1))] = 57.855$$

$$\text{Cost of breakdown} = (57.855) \times (\text{₹ } 3,000) = \text{₹ } 1,73,565$$

$$\text{Cost of preventive maintenance} = 50 \times \text{Rs } 500 = \text{₹ } 25,000$$

$$\text{Total} = \text{₹ } 1,98,565$$

$$\text{Therefore, cost per month for this policy is } \text{₹ } 1,98,565 \div 4 \text{ months} = \text{₹ } 49,641.25$$

Comparing the costs per month of different policies, we see that the policy of preventive maintenance every two months is the most economic policy.

Section C

There are three questions in this Section. Answer any two questions.

15×2=30

1. (a) State the important characteristics of useful and effective information. 8
(b) In the context of DBMS, define the following in one or two sentences:
(i) Universe of Discourse; and (ii) Data Model. 2+2=4
(c) From the following two relations of X and Y, find $X \cup Y$. 3

Relation X	
Batch No.	Course
1	BA
2	BSC
3	BCOM

Relation Y	
Batch No.	Course
1	BA
2	BSC
3	BCOM
4	MA
5	MSC
6	MCOM

Answer:

(a) The important characteristics of useful and effective information are as follows:

- (i) **Timeliness:** For effective decision-making, decision maker should get the information in right time. Timeliness refers to when user needs the information. Some information is required on regular, periodic basis - perhaps daily, weekly, monthly or quarterly, while much other information is generated on the request of the manager.
- (ii) **Purpose:** Information must have purposes at the time it is transmitted to a person or machine, otherwise, it is simple data. It helps in creating new concepts, identifying problems, solving problems, decision making, planning and controlling.
- (iii) **Mode and Format:** The mode of communicating information in business are either visual, verbal or in written form. Some information may also be presented in the form of diagram, graph, curves.
- (iv) **Completeness:** The information should be as complete as possible. Incomplete information can result in a wrong decision which may lead to a high cost to the organization. Hence, whenever there is an incomplete information, it should be communicated to the user of the information.
- (v) **Reliability:** Information should be reliable and it must be from the reliable sources.
- (vi) **Cost benefit analysis:** The benefits that are derived from the information must justify the cost incurred in procuring information.
- (vii) **Quality:** It refers to the correctness of information, hence, proper internal controls and procedures should be developed.
- (viii) **Transparency:** If information does not reveal directly what we want to know for decision making, it is not transparent.

(b) (i) **Universe of Discourse:** A database represents some aspect of the real world, sometimes called the **mini—world** or the **Universe of Discourse (UoD)**. Changes to

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the mini-world are reflected in the database.

- (ii) **Data Model:** A data model is a type of data abstraction that is used to provide the conceptual representation. The data model uses logical concepts, such as objects, their properties, and their interrelationships, that may be easier for most users to understand than computer storage concepts, Hence, the data model hides storage and implementation details that are not of interest to most database users.

(c) X U Y =

Relation X U Y	
Batch No.	Course
1	BA
2	BSC
3	BCOM
4	MA
5	MSC
6	MCOM

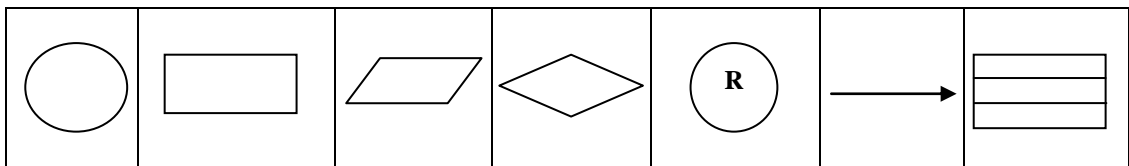
2. (a) Explain the characteristics of Client Server platform in ERP architecture. 5
 (b) Draw important symbols used in flow chart and also state limitations of using Flow Chart. 3+3=6
 (c) Fill in the blanks in the context of MIS: 1×4=4
- (i) Customers' _____ level is one of the critical success factors.
 (ii) The use of computers increases the _____ of MIS.
 (iii) MIS is important to managers in the process of _____.
 (iv) Depending on the level of management, different _____ areas will require different types of reports.

Answer:

(a) The characteristics of Client Server platform in ERP architecture are:

- Server hosts central database and application programmes.
- PC Clients, provide input, request service from server, performs display and does some processing.
- System functions are done in three logical layers (i) Presentation layer-at client PC (ii) Application layer, executing instructions from users and transferring and receiving data from database (iii) Database layer for centrally managing data. Under C/S concept, server denotes either a physical or a virtual server.
- Application programmes and database may be hosted in a single server or in two separate servers. For multi-location or large systems, application program is divided in a number of networked servers which enhance speed and reliability of the system.
- Monolith system of mainframe era gave away to multilayered and decentralized architecture of C/S. Consequently, ERP vendors started adopting more and more Object Oriented Program (OOP) and third/fourth generation programming language (3GL/4GL). This componentized development environment enables them to develop more modular solutions which can be customized, tested, deployed and retrofitted easily and separately.

(b) Some important symbols used in flowchart are:



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Start/ Stop	Assignment/ Calculation	Input/ output	Decision Making	Connector	Flow Lines	Subroutine
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Limitations of using Flowcharts:

- **Complex logic:** Sometimes, the program logic is quite complicated. In that case, flowchart becomes complex.
- **Alterations and Modifications:** If alterations are required, the flowchart may require redrawing completely.
- **Reproduction:** As the flowchart symbols cannot be typed, reproduction of flowchart becomes a problem.

(c) (i) Satisfaction, (ii) Effectiveness, (iii) Decision-making, (iv) Functional.

3. (a) Explain the three-schema architecture in DBMS. 3
(b) State the effects of using computers for MIS. 7
(c) Expand the following: 1×5=5
(i) EFT (ii) ISP (iii) AP (iv) TPS (v) LAN

Answer:

(a) The goal of the three-schema architecture is to separate the user applications and the physical database. In this architecture, schemas can be defined at the following three levels:

- (i) The internal level has an internal schema, which describes the physical storage structure of the database. The internal schema uses a physical data model and describes the complete details of data storage and access paths for the database.
- (ii) The conceptual level has a conceptual schema, which describes the structure of the whole database for a community of users. The conceptual schema hides the details of physical storage structures and concentrates on describing entities, data types, relationships, user operations, and constraints. A high level data model or an implementation data model can be used at this level.
- (iii) The external or view level includes a number of external schemas or user views. Each external schema describes the part of the database that a particular user group is interested in and hides the rest of the database from that user group. A high-level data model or an implementation data model can be used at this level.

(b) **Effects of Using Computer for MIS:**

- (i) **Increase in speed of processing and retrieval of data:** Computer with its fast Computational capability and systematic storage of information with random access facility has emerged as an answer to the problems faced in modern days management.
- (ii) **Expansion in the scope of use of information system:** System experts in business Organizations developed the areas and functions, where computerized MIS could be used to improve the working of the concern. These types of applications are not feasible under the manual system.
- (iii) **Scope of analysis widened:** The use of computer can provide multiple type of information accurately and which makes the decision fast.
- (iv) **Complexity of system design and operation increased:** The computer manufacturers have developed some important programs software to help the users, which are self-explanatory and require minimum system experts.
- (v) **Integrates the working of different information subsystem:** There are number of subsystems like production, material, marketing, finance, engineering and personnel which are integrated only due to applying computer technology to MIS.

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(vi) Increases the effectiveness of information systems: Before the existence of computer technology, it was difficult to provide the relevant information to business executives in time even after incurring huge expenses. The use of computer technology has overcome this problem, by providing timely, accurate and desired information for the purpose of decision-making.

(vii) More comprehensive information: The use of computer for MIS enabled system expert to provide more comprehensive information to executives on business matters.

(c)

Abbreviation	Expansion
EFT	Electronic Financial Transaction
ISP	Internet Service Provider
AP	Accounts Payable
TPS	Transaction Processing System
LAN	Local Area Network

Chapter references as indicated in Table above.