PAPER 9 - OPERATIONS MANAGEMENT & INFORMATION SYSTEM

The following table lists the learning objectives and the verbs that appear in the syllabus learning aims and examination questions:

	Learning objectives	Verbs used	Definition
LEVEL B	KNOWLEDGE What you are expected to know	List	Make a list of
		State	Express, fully or clearly, the details/facts
		Define	Give the exact meaning of
	COMPREHENSION What you are expected to understand	Describe	Communicate the key features of
		Distinguish	Highlight the differences between
		Explain	Make clear or intelligible/ state the meaning or purpose of
		Identity	Recognize, establish or select after consideration
		Illustrate	Use an example to describe or explain something
	APPLICATION How you are expected to apply your knowledge	Apply	Put to practical use
		Calculate	Ascertain or reckon mathematically
		Demonstrate	Prove with certainty or exhibit by practical means
		Prepare	Make or get ready for use
		Reconcile	Make or prove consistent/ compatible
		Solve	Find an answer to
		Tabulate	Arrange in a table
	ANALYSIS How you are expected to analyse the detail of what you have learned	Analyse	Examine in detail the structure of
		Categorise	Place into a defined class or division
		Compare and contrast	Show the similarities and/or differences between
		Construct	Build up or compile
		Prioritise	Place in order of priority or sequence for action
		Produce	Create or bring into existence

Paper 9 - Operations Management & Information System

Full Marks: 100 **Time allowed-3hrs**

This paper contains 3 questions. All questions are compulsory, subject to instruction provided against each question. All workings must form part of your answer. Assumptions, if any, must be clearly indicted.

Question No. 1 : Answer all questions. [20 marks]

1. (a) Explain the term Operations Design.
(b) A work study practitioner who conducted a work sampling study assesses the activity level of a worker to be 65%. During the space of 8 hours working, this worker turns out 300 components. If the company policy is to inflate the normal time arrived at by work sampling study by 20%, what should be the allowed time per unit?
(c) 'Capacity available and capacity required are measured in the following time span"- List the plans.
(d) Explain the term Aggregate Planning.
(e) Explain the term Predictive Maintenance.
(f) State the meaning of Technology Fusion.
(g) State the Software Packages which serve as aids in program analysis.
(h) Describe Conceptual Schema.
(i) List the reasons for failure of an ERP project.
(j) Define 'Verify' in relation to a digital signature. **[10 × 2 = 20]**

Answer:

(a) Operations Design is concerned with the design of the individual manufacturing operation. It examines the man-machine relationship in the manufacturing process. Operations design must specify how much labour and machine time is required to produce each unit of the product.

(b) Activity level as per work sampling study 65%
Actual working time per shift of 8 hours = 8 × 65/100 = 5.2 hours
Normal time taken per unit = $\frac{5.2 \times 60}{300}$ = 1.04 minutes
Allowed time = 1.04 × 120/100 = 1.25 minutes.

(c) Capacity available and capacity required are measured in the following time span:
- Short-term Capacity Requirement Plans.
- Intermediate term Rough Cut Capacity Plans.
- Long-term Resource Requirement Plans.

(d) The term aggregate planning is often employed in the capacity context. The implication is that such planning is concerned with total demand, i.e. all demands collected together. This is of relevance in operating systems where different goods or services are provided. In such cases capacity planning will seek to estimate or measure all demands and express the total in such a way as to enable enough of all resources (or total capacity) to be provided. Demand for all outputs must therefore be expressed in common capacity-related units such as the number of resources or resource hours required.

(e) One of the newer types of maintenance that may be anticipated to gain increasing attention is called predictive maintenance. In this, sensitive instruments (e.g. vibration analysers, amplitude meters, audiogauges, optical tooling,pressure,temperature and resistance gauges) are used to predict trouble. Conditions can be measured periodically or on a continuous basis and this enables the maintenance people to plan for overhaul. This will allow an extension to the service life without fear of failure.

(f) Technology fusion refers to the process of combining several current technologies and scientific knowledge to create a hybrid technology. Adding one technology to another, results in synergic effects. For example in machine tool industry NC, CNC machines are the result of fusion of electronics and mechanical technologies.

(g) Software Packages which serve as aids in program analysis

- Automated flowcharting programs
- Automated decision table programs
- Scanning routines
- Mapping programs
- Program Tracing

(h) 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.

(i) Reasons for failure of an ERP project

- such as lack of commitment from management and employees
- lack of communication
- knowledgeable employees not available for the project
- due to other organizational issues which have nothing to do with technical matters.

(j) 'Verify' in relation to a digital signature electronic record on public key with its grammatical variations and cognate expressions means to determine whether

- The initial electronic record was affixed with the digital signature by the use of private key corresponding to the public key of the subscriber.
- The initial electronic record is retained intact or has been altered since such electronic record was so affixed with the digital signature.

Operations Management

Answer any three questions

2.(a) (i) XYZ Scientific Equipment manufacturing company is engaged in producing different types of high class equipment for use in science laboratories. The company has two different assembly lines to produce its most popular product. The processing time for each of the assembly lines is regarded as a random variable and is described by the following distributions:

Processing time (minutes)	Assembly A_1	Assembly A_2
20	0.20	0.10
21	0.40	0.15
22	0.20	0.40
23	0.15	0.25
24	0.05	0.10

Using the following random numbers, generate data on the process times for 15 units of the item and compute the expected process time for the product:

3441, 7674, 4349, 4383, 8311, 1519, 0236, 4594, 1554, 0575, 8900, 8008, 2874, 2434, 0993
For the purpose, read the numbers horizontally, taking the first two digits for the processing time on assembly A_1 and the last two digits for processing time on assembly A_2. [10]

(ii) Distinguish between PERT and CPM. [6]

(b) (i) Draw network. Determine the critical path and duration of the project. Find total float for each activity. (Duration in days)

Activity	1-2	1-3	1-4	2-5	3-6	3-7	4-6	5-8	6-9	7-8	8-9
Duration	2	2	1	4	8	5	3	1	5	4	3

[14]

(ii) Customers arrive at a booking office window being manned by a single individual at a rate of 25 per hour. The time required to serve a customer has exponential distribution with a mean of 120 seconds. Find the average waiting time of a customer. [2]

(c) (i) The data on the operating costs per year and resale prices of equipment A whose purchase price is ₹1,00,000 are given here:

Year	1	2	3	4	5	6	7
Operating Cost (₹)	15,000	19,000	23,000	29,000	36,000	45,000	55,000
Resale value (₹)	50,000	25,000	12,500	6,000	4,000	4,000	4,000

(a) What is the optimum period for replacement?
(b) When equipment A is 2 years old, equipment B, which is a new model for the same usage, is available. The optimum period for replacement is 4 years with an average cost of ₹36,000. Should we change equipment A with that of B? If so, when? [10]

(ii) State the six basic concepts required for TQM. [6]

(d) (i) Solve the following Assignment problem. The data given in the table refers to production in units:

	Machines			
Operators	A	B	C	D
1	10	5	7	8
2	11	4	9	10
3	8	4	9	7
4	7	5	6	4
5	8	9	7	5

[12]

(ii) For a certain element of work, the basic time is established to be 20 seconds. If for three observations, a time study observer records ratings of 100,125 and 80 respectively, on a '100 normal scale' what are the observed timings? [4]

Answer:

(a) **(i)** Random Number Coding for process times (A_1)

Time (minutes)	Prob.	Cum Prob.	RN Interval
20	0.20	0.20	00-19
21	0.40	0.60	20-59
22	0.20	0.80	60-79
23	0.15	0.95	80-94
24	0.05	1.00	95-99

Random Number Coding for process times (A_2)

Time (minutes)	Prob.	Cum Prob.	RN Interval
20	0.10	0.10	00-09
21	0.15	0.25	10-24
22	0.40	0.65	25-64
23	0.25	0.90	65-89
24	0.10	1.00	90-99

The random numbers for the first unit are 34 and 41 respectively for the assemblies A_1 and A_2.

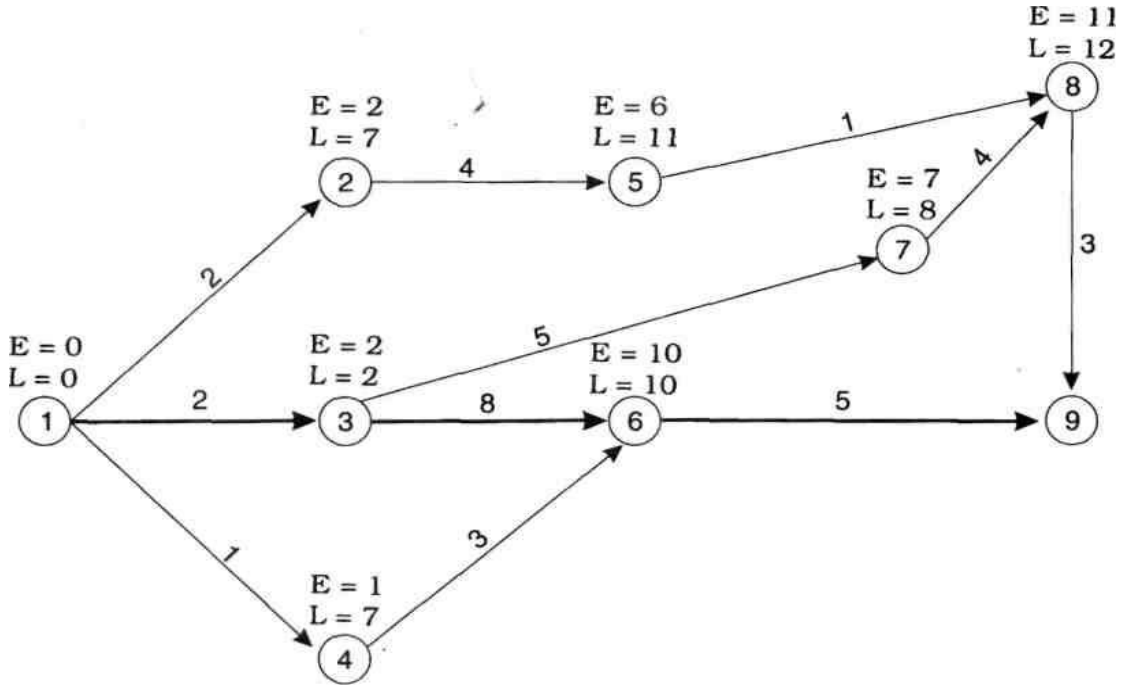
Simulation Worksheet

Unit	Assembly A_1		Assembly A_2		Total time(mins)
	R. Number	Time	R. Number	Time	
1	34	21	41	22	43
2	76	22	74	23	45
3	43	21	49	22	43
4	43	21	83	23	44
5	83	23	11	21	44
6	15	20	19	21	41
7	02	20	36	22	42
8	45	21	94	24	45
9	15	20	54	22	42
10	05	20	75	23	43
11	89	23	00	20	43
12	80	23	08	20	43
13	28	21	74	23	44
14	24	21	34	22	43
15	09	20	93	24	44
				Expected Time = 649/15	43.27

(ii)

PERT	CPM
Time estimate is probabilistic with uncertainty in time duration. Three time estimates.	Time estimate is deterministic with known time durations. Single time estimate.
Event oriented.	Activity oriented.
Focused on time.	Focused on time-cost trade off.
More suitable for new projects.	More suited for repetitive projects.
Most costly to maintain.	Easy to maintain.
Suitable for complex projects where uncertain timing like research programs.	Suitable where problems of resource allocation exist like construction projects.
Dummy activity required for proper sequencing.	Use of dummy activity not necessary.

(b) (i)



The critical path is 1 – 3 – 6 – 9. Its duration is 15 days.

Activity	Duration	ES	LF	EF	LS	TF
1 -2	2	0	7	2	5	5
1 -3	2	0	2	2	0	0
1 -4	1	0	7	1	6	6
2 -5	4	2	11	6	7	5
3 -6	8	2	10	10	2	0
3 -7	5	2	8	7	3	1
4 -6	3	1	10	4	7	6
5 -8	1	6	12	7	11	5

6 -9	5	10	15	15	10	0
7 -8	4	7	12	11	8	1
8 -9	3	11	15	14	12	1

(ii)

Here we are given,

Arrival rate (λ) = 25 per hour

Service rate (μ) = $\frac{60 \times 60}{120}$ = 30 per hour.

Average waiting time of a customer in queue:

$W_q = \frac{\lambda}{\mu(\mu - \lambda)} = \frac{25}{30(30 - 25)} = \frac{1}{6}$ hrs. or 10 minutes.

(c) (i)

(a) The Purchase Price (C)= ₹1,00,000.

The determination of the optimal period of replacement of equipment A is given in table below:

Determination of Optimal Replacement Period

Year (I)	Op. Cost(M_t) (₹) (II)	Cum M_t (₹) (III)	Resale Value (S) (₹) (IV)	C-S (V)	T(n) (VI=III +V)	A(n) (VII=VI/I)
1	15,000	15,000	50,000	50,000	65,000	65,000
2	19,000	34,000	25,000	75,000	1,09,000	54,500
3	23,000	57,000	12,500	87,500	1,44,500	48,167
4	29,000	86,000	6,000	94,000	1,80,000	45,000
5	36,000	1,22,000	4,000	96,000	2,18,000	43,600
6	45,000	1,67,000	4,000	96,000	2,63,000	43,833
7	55,000	2,22,000	4,000	96,000	3,18,000	45,429

Since the average cost corresponding to the 5-yearly period is the least, the optimal period for replacement =5 years.

(b) As the minimum average cost for equipment B is smaller than that for equipment A, it is prudent to change the equipment. To decide the time of change, we would determine the cost of keeping the equipment in its 3rd,4th and 5th year of life and compare each of these values with ₹36,000 (the average cost of equipment B).The equipment A shall be held as long as the marginal cost of holding it would be smaller than the minimum average cost for equipment B. The calculations are given as below:

Year	Operating Cost	Depreciation	Total Cost
3	23,000	12,500(=25,000 -12,500)	35,500
4	29,000	6,500(=12,500-6,000)	35,500
5	36,000	2,000(=6,000-4,000)	38,000

Since the cost incurred in keeping the equipment A in the third and the fourth years is less than the average cost for equipment B, the replacement should be done after 2 years.

(ii) TQM requires six basic concepts :

1. A committed and involved management to provide long-term top-to-bottom organizational support.
2. An unwavering focus on the customer, both internally and externally.
3. Effective involvement and utilization of the entire work force.
4. Continuous improvement of the business and production process.
5. Treating suppliers as partners.
6. Establish performance measures for the processes.

A brief paragraph on each of them is given here:

1. Management must participate in the quality program. A quality council must be established to develop a clear vision, set long-term goals and direct the program. Managers participate on quality improvement teams and also as coaches to other teams. TQM is a continual activity that must be entrenched in the culture it is not just a one-shot program. TQM must be communicated to all people.
2. The key to an effective TQM program is its focus on the customer. An excellent place to start is by satisfying internal customers. We must listen to the "Voice of the customer" and emphasize design quality and defect prevention.
3. TQM is an organization-wide challenge that is everyone's responsibility. All personnel must be trained in TQM, statistical process control (SPC) and other appropriate quality improvement skills so they can effectively participate on project teams.
   People must come to work not only to do their jobs, but also to think about how to improve their jobs, people must be empowered at the lowest possible level to perform processes in an optimum manner.
4. There must be a continue striving to improve all business and production processes. Quality improvement projects, such as on-time delivery, order-entry efficiency, billing error rate, customer satisfaction, cycle time, scrap reduction and supplier management are good places to begin.
5. On the average 40% of the sales is purchased product or service, therefore, the supplier quality must be outstanding. The focus should be on quality and life cycle costs rather than price. Suppliers should be few in number so that true partnering can occur.
6. Performance measures such as uptime, percent non-conforming, absenteeism and customer satisfaction should be determined for each functional area. Quantitative data are necessary to measure the continuous quality improvement activity.

(d) (i)

Introducing Dummy:

	Machines				
Operators	A	B	C	D	Dummy
1	10	5	7	8	0
2	11	4	9	10	0
3	8	4	9	7	0
4	7	5	6	4	0
5	8	9	7	5	0

Opportunity Loss matrix

	Machines				
Operators	A	B	C	D	Dummy
1	1	6	4	3	11

2	0	7	2	1	11
3	3	7	2	4	11
4	4	6	5	7	11
5	3	2	4	6	11

Row reduction

Operators	Machines				
	A	B	C	D	Dummy
1	0	5	3	2	10
2	0	7	2	1	11
3	1	5	0	2	09
4	0	2	1	3	07
5	1	0	2	4	09

Column reduction

Operators	Machines				
	A	B	C	D	Dummy
1	0	5	3	1	3
2	0	7	2	0	4
3	1	5	0	1	2
4	0	2	1	2	0
5	1	0	2	3	2

Minimum lines to cut zeros

	Machines				
Operators	A	B	C	D	Dummy
1	0	5	3	1	3
2	0	7	2	0	4
3	1	5	0	1	2
4	0	2	1	2	0
5	1	0	2	3	2

As the minimum number of lines are equal to order matrix, optimal assignment should be made.

Optimal Assignment

	Machines				
Operators	A	B	C	D	Dummy
1	[0]	5	3	1	3
2	0	7	2	[0]	4
3	1	5	[0]	1	2
4	0	2	1	2	[0]
5	1	[0]	2	3	2

Computing maximum production

Operators	Machines	Units of production
1	A	10
2	D	10

3	C	9
4	Dummy	0
5	B	9
Total		38

(ii)

(Observed time) × (Observed rating)= (Basic or normal time) × (standard rating)

$$\text{Observed time} = \frac{(\text{Basic or normal time}) \times (\text{Standard rating})}{\text{Observed rating}}$$

Basic or normal time =20 seconds
Given, standard rating =100
For observation no. 1, observed rating =100

$$\text{Observed time} = \frac{20 \times 100}{100} = 20 \text{seconds}$$

$$\text{For observation no. 2, observed time} = \frac{20 \times 100}{125} = 16 \text{ seconds}$$

$$\text{For observation no. 3, observed time} = \frac{20 \times 100}{80} = 25 \text{ seconds}$$

Information System

Answer any two questions.

3. (a) (i) Explain the different activities involved in system conversion. [5]
(ii) Describe Transform Analysis. [3]
(iii) Explain the different types of end users. [5]
(iv) List the advantages of coding information. [3]

(b) (i) 'ERP is not confined to manufacturing only but covers all facets of organization".-list them. [2]
(ii) Describe the major characteristics of Transaction Processing System. [4]
(iii) List the intangible benefits of ERP. [3]
(iv) List the steps to be followed for establishment of MIS in an organization. [7]

(c) (i) State the notable features of the Information Technology Amendment Act, 2008. [6]
(ii) Explain the term Electronic Financial Transaction. [4]
(iii) State the uses of Electronic Data Interchange. [2]
(iv) Describe the set up of General Ledger master data. [4]

Answer:

(a)

(i) Activities involved in conversion: These activities are classified as follows:

(a) Procedure conversion: Operating procedures should be completely documented for the new system. Brief meetings must be held when changes are taking place in order to inform all operating employees of any changes initiated.

(b) File conversion: Because large files of information must be converted from one medium to another. In order for the conversion to be as accurate as possible, file conversion programs must be thoroughly tested. Adequate controls, such as record counts and control totals, should be the required output of the conversion program.

(c) System conversion: A cutoff point is established so that data base and other data requirements can be updated to the cutoff point. All transactions initiated after this time are processed on the new system. Consideration should be given to operating the old system for some more time to permit checking and balancing the total results of both systems.

(d) Scheduling personnel and equipment: Some programs might be operational while others will be in various stages of compiling and testing. Schedules should be set up by the system manager in conduction with departmental managers of operational units.

(e) Alternative plans in case of equipment failure: Alternative-processing plans must be implemented in case of equipment failure. Priorities must be given to those jobs critical to an organization, such as billing, payroll, and inventory. Critical jobs can be performed manually until the equipment is set right.

(ii) Transform analysis is an examination of the DFD to divide the processes into those that perform input and editing, those that do processing or data transformation (e.g., calculations), and those that do output.

- The portion consisting of processes that perform input and editing is called the afferent.
- The portion consisting of processes that do actual processing or transformations of data is called the central transform.
- The portion consisting of processes that do output is called the efferent.

(iii) End users are the people whose jobs require access to the database for querying, updating, and generating reports; the database primarily exists for their use. There are several categories of end users:

- Casual end users occasionally access the database, but they may need different information each time. They use a sophisticated database query language to specify their requests and are typically middle- or high-level managers or other occasional browsers.

- Naive or parametric end users make up a sizable portion of database end users; Their main job function revolves around constantly querying and updating the database, using standard types of queries and updates−called canned transactions−that have been carefully programmed and tested. The tasks that such users perform are varied:

  - Bank tellers check account balances and post withdrawals and deposits.
  - Reservation clerks for airlines, hotels, and car rental companies check availability for a given request and make reservations.

- Clerks at receiving stations for courier mail enter package identifications via bar codes and descriptive information through buttons to update a central database of received and intransit packages.

- Sophisticated end users include engineers, scientists, business analysts, and others who thoroughly familiarize themselves with the facilities of the DBMS so as to implement their applications to meet their complex requirements.

- Stand-alone users maintain personal databases by using ready-made program packages that provide easy-to-use menu- or graphics-based interfaces. An example is the user of a tax package that stores a variety of personal financial data for tax purposes.

(iv) Information is often coded because:

- It is quicker to enter into the computer
- It require less disc space to store, and less memory to process
- It can make processing easier - or possible - as there will be fewer responses
- It improves the consistency of the data as spelling mistakes are less likely
- Validation is easier to apply.

(b)

(i) ERP is not confined to manufacturing only but covers all facets of organization such as:
- Finance
- Human Resources
- Supply Chain
- Warehouse management, and
- Project Management

(ii) The Major Characteristics of TPS
- Large amounts of data are processed.
- The sources of data are mostly internal, and the output is intended mainly for an internal audience.
- The TPS processes information on a regular basis: daily, weekly, monthly, etc.
- Large storage (database) capacity is required.
- High processing speed is needed due to the high volume.
- TPS basically monitors and collects past data.
- Input and output data are structured (i.e., standardized).
- Low computation complexity is usually evident in TPS.
- A high level of accuracy, data integrity, and security is needed.
- High reliability is required.
- Inquiry processing is a must.

(iii) In addition to tangible benefits, following intangible benefits also occur:
- Integration of information resulting efficiency, transparency and effective MIS.
- Error reduction, accuracy of inventory record.
- Improved customer service, on time shipment, shorter order to shipment cycle.
- Establishment of standardized procedures.
- Improved accounting control and shorter sales to cash cycle.
- Legal and regulatory compliance.

(iv) 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 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 steps 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

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.

(c)

(i) Some of the notable features of the Information Technology Amendment Act are as follows:

- Focusing on data privacy
- Focusing on Information Security
- Defining cyber café
- Making digital signature technology neutral
- Defining reasonable security practices to be followed by corporate
- Redefining the role of intermediaries
- Recognizing the role of Indian Computer Emergency Response Team
- Inclusion of some additional cyber crimes like child pornography and cyber terrorism
- Authorizing an Inspector to investigate cyber offences (as against the DSP earlier)

(ii) Electronic Financial Transaction (EFT) refers to a process by which money is transferred from one person's bank account to another person's account electronically rather than using a cheque or transferring cash. Of course, these electronic transfers are also available to governments and businesses.

The individuals or governments or businesses using them authorize these electronic transactions in writing. The transactions are processed through the Automated Clearing House (ACH) Network.

Organizations using the network have formed an association, National Automated Clearing House Association.

(iii)

EDI is used in following ways:

1. EDI is used to electronically transfer documents such as purchase order, invoices, shipping notices, receiving advises and other standard business correspondence between the trading partners.

2. EDI can also be used to transmit financial information and payment in electronic form. However, where EDI is used for effecting payment it is commonly known as financial EDI or electronic funds transfer.

(iv) One of the important processes of GL is setting up of Chart of Accounts, which is a complete structure of ledger accounts used by the organization. Chart of Accounts can be flexibly structured both at a parent and individual company level. Chart of Account may also be defined separately for statutory purpose as well as for the purpose of reporting to management. In some packages, the concept of dimension is used which gives a vertical view on ledger account. Another important parameter of GL is transaction type which identifies different categories of transactions such as journal voucher, sales invoice, cash, and corrections. Other important parameters of GL are (i) parent company

and company parameters (this will contain accounts for profit and loss, currency fluctuations etc. (ii) Periods (Fiscal and Tax), (iii) Tax code by countries.