INTERMEDIATE EXAMINATION

(REVISED SYLLABUS - 2008)

GROUP - II

Paper-9 : OPERATION MANAGEMENT AND INFORMATION SYSTEMS

Section I : Operation Management

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

(i) Information on consumption of materials is available from :

- **(a) job card**
- **(b) material requisitions**
- **(c) inventory card**
- **(d) work study**

(ii) Value engineering stresses upon :

- **(a) profit maximization**
- **(b) human relation**
- **(c) method study**
- **(d) functional analysis**

(iii) A process layout is useful when :

- **(a) demand for the product is high.**
- **(b) paper work is to be minimized.**
- **(c) in process inventory is to be low.**
- **(d) flexibility in production is required.**

(iv) For movement of materials in a fixed path, the equipment should be :

- **(a) belt conveyors.**
- **(b) fork lift trucks.**
- **(c) mobile cranes.**
- **(d) hand trolleys.**

(v) The design of a good material handling system should focus on :

- **(a) the speedy movement of materials.**
- **(b) the minimization of material handling.**
- **(c) the maximization of profits.**

(d) the minimization of fixed investment.

(vi) Gantt chart is concerned with :

(a) monitoring progress of job.
(b) wage payment system.
(c) job evaluation.
(d) none of the above.

(vii) Relaxation Allowances are considered in :

(a) Time Study
(b) Method Study
(c) Ergonomic Study
(d) Feasibility Study

(viii) Addition of value to raw materials through application of technology is :

(a) Product
(b) Production
(c) Advancement
(d) Transformation

(ix) Control chart for proportion of defectives is :

(a) c-chart
(b) N-chart
(c) X chart
(d) p chart

(x) Capacity is :

(a) Long term concept.
(b) Maximum available output.
(c) Not related to cost of production.
(d) All of the above.

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

(i) Therbligs normally form part of a _____ chart.
(ii) Rucker plan is a _____ incentive plan.
(iii) Production management is a _____function.
(iv) The _____schedule will contain only key milestones.
(v) _____is a process that bakes on a white, brittle finish.
(vi) _____is the process of ensuring that work is carried out as planned and delivery dates are met.
(vii) Method study should _____work measurement.
(viii) AFTWAYS is a system of _____ .
(ix) The Pattern Shop directly feeds the _____in a factory.
(x) X chart is _____chart.

Answer 1. (A)

(i) (b) material requisitions
(ii) (d) functional analysis
(iii) (d) flexibility in production is required
(iv) (a) belt conveyors
(v) (b) the minimization of material handling
(vi) (a) monitoring progress of job
(vii) (a) Time Study
(viii) (b) Production
(ix) (d) p chart
(x) (b) Maximum available output

Answer 1. (B)

(i) SIMO
(ii) group
(iii) line
(iv) RAT
(v) Enamelling
(vi) Expediting
(vii) precede
(viii) Job Analysis
(ix) foundry
(x) mean

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

Column A	*Column B*
(i) Brain storming	**(a) Net work Analysis.**
(ii) Crashing	**(b) Statistical Quality Control**
(iii) Replacement	**(c) Metal Cutting**
(iv) Normal Curve	**(d) Priority Rules**
(v) BMT	**(e) Value Analysis.**
(vi) Broaching	**(f) Surface Treatment**
(vii) FSN Analysis	**(g) Marketing strategy**
(viii) Pickling	**(h) Maintenance**
(ix) SOT	**(i) Inventory Control**
(x) USP	**(j) Work measurement technique**

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

(i) GOLF
(ii) IMIS
(iii) MPS

(iv) OEM
(v) MAPE
(vi) BOLT
(vii) SDE
(viii) RFQ
(ix) CAN-Q
(x) LTPD

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

(i) Dummy Activities are used in Network Analysis.
(ii) Loading implies release of work orders for start of operations.
(iii) Commercialisation is the last stage in product planning and development.
(iv) An automatic foundry producing a variety of engine castings should have product layout.
(v) Preventive maintenance is useful in reducing inspection cost.
(vi) Organic Coatings are commonly used to improve resistance to corrosion.
(vii) Games theory deals with games which business executives play during lunch interval.
(viii) EOQ formula does not consider storage cost.
(ix) The aim of value engineering is to reduce work content of a job.
(x) In a waiting line problem, the customer arrival is expected to follow Poisson distribution.

Answer 2. (A)

(i) — (e)
(ii) — (a)
(iii) — (h)
(iv) — (b)
(v) — (j)
(vi) — (c)
(vii) — (i)
(viii) — (f)
(ix) — (d)
(x) — (g)

Answer 2. (B)

(i) OLF — Government, Ordinary, Local and Foreign.
(ii) IMIS — Integrated Management Information System.
iii) MPS — Master Production Schedule.
(iv) OEM — Original Equipment Manufacturer.
(v) MAPE — Mean Absolute Percent Error.
(vi) BOLT — Built, Operate, Lease and Transfer.
(vii) SDE — Scarce, Difficult and Easy to procure.
(viii) RFQ — Request for Quotation.

(ix) CAN-Q — Computer Analysis of Network of Queues.

(x) LTPD — Lot Tolerance Percent Defective.

Answer 2. (C)

(i) **True.**

(ii) **False** — Loading is the process of assigning specific jobs to men, machines and work centres on basis of their relative capacities.

(iii) **True**.

(iv) **False** — It should have process layout.

(v) **False** — It helps in reducing shutdown cost.

(vi) **True**.

(vii) **False** — Games theory is a mathematical method for analyzing calculated circumstances, such as in games, where a person's success is based upon the choices of others.

(viii) **False** — EOQ does not consider stock out cost.

(ix) **False** — Value engineering (VE) is a systematic method to improve the "value" of goods or products and services by using an examination of function.

(x) **True**.

Q. 3. (a) List six temporary ways of meeting the demand for a product which is highly variable from time to time.

(b) Define (i) design capacity (ii) effective capacity.

(c) On basis of data given below, calculate (i) Efficiency ratio, (ii) Production Volume ratio and (iii) Idle capacity ratio.

Particulars	Std. Hrs of output	Hrs. of actual operation
Theoretical capacity	100	100
Unavoidable lost time	5	5
Planned activity for period	81	90
Actual activity for period	68	85

Answer 3. (a)

Six temporary ways of meeting demand for a product are as follows :

(i) During peak demand jobs may be subcontracted.

(ii) Additional staff may be employed on contract basis.

(iii) Additional stock may be maintained to meet additional demand.

(iv) Additional output may be obtained through overtime or additional shifts.

(v) Repairs and maintenance programmes may be deferred to make machines available for production.

(vi) Training may be imparted to employees in several tasks.

Answer 3. (b)

The term capacity refers to an upper limit or ceiling on the load that an operating plant can handle. It is highest quantity of output one can get during a given time.

(i) **Design capacity** – Design capacity is the maximum rate of output achieved under ideal conditions. It is decided during the product designing stage to functionally meet the requirements.

ii) **Effective capacity** – Effective capacity is maximum possible output given realities of changing product mix, the need for periodic maintenance of equipment, lunch breaks, coffee breaks, problems in scheduling and balancing operations, and other similar circumstances. Effective capacity is usually less than design capacity. Alteration in product design or functional requirements takes place from time to time. Designer has some freedom in selection of basic processes and materials.

Answer 3. (c)

(i) Efficiency ratio = Std. Hrs of Actual Production/Actual Hrs worked × 100

= 68/85 × 100 = 80%

(ii) Production Volume ratio = Std. Hrs of Actual Production/Budgeted Std. Hrs × 100

= 68/81 × 100 = 83.95%

(iii) Practical capacity = Theoretical capacity – Unavoidable lost time.

Idle capacity ratio = (Std. Hrs of practical capacity-Budgeted std. hrs)/Std. hrs of practical capacity × 100 = (95-81)/95 × 100 = 14/95 × 100 = 14.74%.

Q. 4. (a) State the machine tools to be used to produce the following :

(i) Teeth on a gear wheel.

(ii) Portion of shaft to be supported in a bearing sleeve.

(iii) A Flat surface on a large foundation block.

(iv) A 'U' –shaped groove on a Shaft.

(v) Thread in a nut.

(b) What types of manufacturing processes are employed for the manufacture of :

(i) Hollow shaped castings.

(ii) Mild steel plates.

(iii) Porous metal filters.

(iv) Hook attached to a chain for lifting load.

(v) Steel wire.

(c) Carbide Ltd. manufactures three different items of tools. The time required to produce each tool on different operations is as follows :

Operations	Time in minutes		
	Drills	Cutters	Reamers.
Turning	16	34	40
Grinding	10	8	17
Milling	4	5	8
Heat Treatment	3	3	3
Other data available:			
Sales per annum(units)	18000	20000	15000
Opening Stock(units)	5000	6000	–
Closing Stock(units)	2000	3000	4000

The workers are trained in each trade as such their services are interchangeable. They are paid at ₹ 27.50/- per hour. The workers are paid for 2500 hours per annum which includes 200 hours

for leave which time substitute operators are appointed and for 300 hours the machines are taken for overhaul. Using the above data, calculate:

(i) The production quantity.

(ii) No. of operators required per annum.

(iii) Annual direct labour cost on each type of tool, and

(iv) Indirect labour cost giving breakup of leave wages, overhaul time and idle time wages.

Answer 4. (a)

(i) Milling machine.
(ii) Grinding Machine.
(iii) Planing Machine.
(iv) Shaping Machine
(v) Lathe

Answer 4. (b)

(i) Centrifugal Casting
(ii) Hot Rolling
(iii) Powder metal filters
(iv) Drop forging
(v) Wire Drawing

Answer 4. (c)

(i) Production quantity (units) :

Particulars	Drills	Cutters	Reamers
Sales	18000	20000	15000
Add : Closing Stock	2000	3000	4000
	20000	23000	19000
Less : Opening Stock	5000	6000	-
Production quantity	15000	17000	19000

(ii) No. of operators per annum :

		Hours Required				
Product	**No. of units**	**Turning**	**Grinding**	**Milling**	**Heat Treatment**	**Total**
Drills	15000	4000	2500	1000	750	8250
Cutters	17000	9633	2267	1417	850	14167
Reamers	19000	12667	5383	2533	950	21533
Total		26300	10150	4950	2550	43950
No. of operators required at (2500-300) hours = 2200 hours p.a rounded off to full operator		12	5	3	2	22

(iii) Annual direct labour cost (Rate per hour ₹ 27.50) :

	Drills	Cutters	Reamers	Total
Direct labour hours	8250	14167	21533	43950
Direct labour cost. (₹)	226875	389592.50	592157.50	1208625

(iv) Indirect labour cost :

	Turning	Grinding	Milling	Heat Treatment	Total
No. of Hrs taken (no. of operators × 2200)	26400	11000	6600	4400	
Total hours required as above	26300	10150	4950	2550	
Idle time hrs	100	850	1650	1850	
Leave hrs. (no. of operators × 200)	2400	1000	600	400	
Overhaul hrs.	3600	1500	900	600	
Leave wages (leave hrs. × ₹ 27.50)	66000	27500	16500	11000	121000
Overhaul time wages (overhaul hrs. × 27.50)	99000	41250	24750	16500	181500
Idle time wages (idle time hrs × 27.50)	2750	23375	45375	50875	122375
Indirect labour cost	167750	92125	86625	78375	424875

Q. 5. (a) "Capital productivity includes corporate productivity." Comment.

(b) A company wants a special tool. It has procured 4 nos. of these tools from a vendor for the first time on developmental order basis. It has paid ₹ 11500/- per tool to the vendor as per the vendor's break up of cost, indicated below :

Material ₹ 5500/-, Labour ₹ 2000/-, Overheads ₹ 2500/-, Profit @15% = ₹ 1500/-

The company wants to order four more of these special tools. What would be a reasonable price for these four, in your opinion, if it is found that a 80% learning curve applies for the job.The vendor believes in a slab system of overhead charging i.e a constant rate per unit from 1 to 10 nos.

(c) What are the effects of an increase in specialization of a production/operation system on the following :

(i) Fixed Costs.

(ii) Operating Costs.

(iii) Product quality

(iv) Delivery time

(v) Flexibility.

Answer 5. (a)

Capital productivity indicates the effective utilization of fixed as well as working capital. Thus a high degree of fixed assets turnover may signify better capacity utilization provided age of the machine and depreciation is suitably taken care of : the lower average collection period as manifest in receivables turnover may signify better marketing performance : a higher stock turnover may indicate the efficiency of the material management function etc.

The corporate productivity measuring indices are generally quite broad: Earning per share, Dividend yield, ROI, Profitability, Return on Net Worth, Debt –Equity etc are some of the widely accepted criteria for this purpose.

Any betterment in capital productivity may be translated into minimization of idle time of machines, lessor financial cost etc. All these lead to higher corporate productivity.

The given statement 'Capital productivity includes corporate productivity' may be judged from this angle.

As is obvious, buried beneath any corporate productivity figure are myriads of individual decisions affecting capital productivity as well as hundreds of exogenous factors not necessarily related to capital productivity. To this extent the given statement should have been read as 'corporate productivity includes capital productivity' and not the other way round.

Answer 5. (b)

Special tool cost :

	₹/Unit
Material	5,500
Labour	2,000
Overheads	2,500
	10,000
Add : Profit@15%	1,500
Price per unit	11,500

Considering a 80% learning curve,

Unit	Total Cost (Labour) (₹)	Av. Cost/Unit (Labour) (₹)
4	8000	2000
8	12800	2000 × 0.8 = 1600

So incremental labour cost for second order = 12800 – 8000 = 4800

Reasonable price would be, therefore,

		₹
Material	(4 × 5500)	22,000
Labour	as above	4,800
Overheads	(4 × 2500)	10,000
		36,800
Add: Profit		5,520
Price for 4 tools		42,320
Price per tool		10,580

Answer 5. (c)

Effect of an increase in specialization of a production / operation system may be highlighted as below:

(i) Fixed Cost will go up.

(ii) Operating cost will come down.

(iii) Product quality is expected to be improved.

(iv) Delivery time will be reduced.

(v) Production rate will go up.

(vi) Flexibility will be reduced.

Q. 6. (a) Management Accountant Associates promotes its management development seminars by mailing thousands of individually composed invitations along with brochures to its members and industrial organizations. A time study was conducted on the task of preparation of invitation & brochures for mailing. On basis of following observations the Associate wants to develop a standard time for this job. The personal, fatigue and delay allowance factor is 15%. Compute the standard time.

	Observations (minutes)					
Job Element	**1**	**2**	**3**	**4**	**5**	**Performance Rating**
(P) Compose Invitation	**8**	**10**	**9**	**21**	**11**	**120%**
(Q) Attach the invitation & brochures with email address of members/organisations	**2**	**3**	**2**	**1**	**3**	**105%**
(R) Mail the invitation	**2**	**1**	**5**	**2**	**1**	**110%**

(b) How are labour standards established, and what are their principal uses?

(c) Mention in brief, some "allowances" used in work measurement and their scope.

Answer 6. (a)

The non recurring observations may be deleted while computing average time for each job element.

Average time for each job element :

Average time for P = (8+10+9+11)/4 = 9.5 min

Average time for Q = (2+3+2+1+3)/5 = 2.2 min

Average time for R = (2+1+2+1)/4 = 1.5 min

Normal time for each job element :

Normal time for P = (Av. Observed time) × Performance Rating.
= 9.5 × 120% = 11.4 min

Normal time for Q = 2.2 × 105%
= 2.31 min

Normal time for R = 1.5 × 110%
= 1.65 min

Total Normal Time = 11.4 + 2.31 + 1.65 min = 15.36 min.

Standard Time for the job = Total Normal Time/(1–Allowance factor)
= 15.36/(1 – .15) = 18.07 min.

Thus standard time for the task is 18.07 min.

Answer 6. (b)

The labour standards may be established by any or many of the following :

(i) Time Study/ Work Measurement techniques using analytical estimation, stop watch time study, activity sampling etc.

(ii) Through observation and judgmental basis ; past records in terms of time booking etc. may be used for the purpose.

(iii) By synthesizing predetermined elemental time data.

Principal uses of these standards are :

(i) For labour cost control through proper incentive scheme, training, transfer etc.

(ii) Measuring of productivity and variances;

(iii) In estimating the labour cost for a job (particularly in job shop and batch type industry).

(iv) Productivity bargaining

(v) Checking the effectiveness of a change in method and/or technology.

Answer 6. (c)

The various 'allowances' used are as follows :

Personal and Fatigue allowances : Personal allowance is provided to allow time for workers' personal needs such as getting a drink, going to washrooms etc.

Fatigue allowance is provided for worker to recover from the fatigue resulting from his performance of work. Obviously this is a function of the efforts exerted and the working environment and the quantum has to be decided through ergonomic researches.

Personal and fatigue allowances constitute the major addition to normal times to arrive at standard time and are usually given as combined percentage under the heading 'Rest and Personal Allowance' or simply 'Relaxation Allowance'.

Contingencies : An allowance of contingencies has to be made to take care of minor interruptions to work such as tool adjustments, tool breakage, getting advice from supervisors, minor breakdowns, etc. The quantum should be decided by shift or work sampling studies for a sufficiently long duration.

Special Allowance: These cover allowances provided for specific situation usually temporary eg. Learning allowance for trainee operators.

Policy Allowance : A policy allowance is sometimes provided by management decisions to ensure a certain level of earnings for workers. It is added to the time standards for computing incentive earnings but does not constitute a part of them.

Q. 7. (a) 'Quality circles have contributed to increased productivity, in general. But they cannot be applied successfully in any and every situation. A few points are basic to the success of a quality circle programme.' Discuss in brief.

(b) Distinguish between 'internal failure' costs and 'external failure' costs, in the quality context.

Answer 7. (a)

Quality Circle has become quite popular in motivating employees through enrichment of their jobs. It underscores the employee interest in participation in management and recognizes the ability of them to contribute. Originally conceived in Japan, the concept gained considerably in its scope and application in USA. Commencing with manufacturing industries, presently it is being used in service units, health care services, etc.

A **quality circle** is a volunteer group composed of workers, usually under the leadership of their supervisor (but they can elect a team leader), who are trained to identify, analyze and solve work-related problems and present their solutions to management in order to improve the performance of the organization, and motivate and enrich the work of employees. When matured, true quality circles become self-managing, having gained the confidence of management. Prima facie it is quite simple. However for effective function

it must have support structure usually in the form of steering committee, facilitators, circle leaders and circle members.

Steering Committee : It liaise with management, provides overall guidance, suggest problems to address, receive, and communicates recommendation and follow up on implementation.

Facilitators : Few circles together have a facilitator having good connection in the organization with strong support from top management. The facilitator provides training to the circle leaders, support training programme to members and arranges information as required by the circle.

Circle leaders : They provide training in problem identification and solution thereof. This position is considered to be an excellent grooming ground for supervisors likely to be promoted.

Circle members : The volunteers are taken from regular work force. They are allowed sometime off per week(usually one hour) to discuss, brain storm, keep the facilitator busy in providing them information. Based on their preliminary findings they choose problems, come out with solution as well as the strategy to implement it. The reaction of steering committee is informed to circle.

Successful quality circles offer a wide variety of benefits to businesses. For example, they serve to increase management's awareness of employee ideas, as well as employee awareness of the need for innovation within the company. Quality circles also serve to facilitate communication and increase commitment among both labor and management. In enhancing employee satisfaction through participation in decision-making, such initiatives may also improve a small business's ability to recruit and retain qualified employees. In addition, many companies find that quality circles further teamwork and reduce employee resistance to change. Finally, quality circles can improve a small business's overall competitiveness by reducing costs, improving quality, and promoting innovation.

Answer 7. (b)

Internal failure costs pertain to failures or defects pinned before the item is dispatched to the customer. It includes , inter alia, the cost of scrap, spoilage, defectives, remark etc. The opportunity cost of item being sold as seconds, loss of goodwill due to delay in shipments as well as the administrative costs incurred in identifying and taking action for defection, wastage, etc. are also relevant in this regard.

External failure costs occur when the defective item is dispatched to the customer. These includes warranty costs, replacement costs, legal costs if any, cost of item returned as well as the costs associated with the handling of complaints. The opportunity costs of losing business may be sizeable.

Q. 8. (a) Management Development Institute conducts seminars, management development programmes, workshops and other academic conventions for industry and management colleges and institutions. It wants to remodel its various functional departments in such a way that one activity space is in physical proximity to another. Mr. X the architect has obtained the following table of pair wise ratings. The rating scale is 1 to 10 with 1 representing the lowest in the importance of proximity of that pair and 10 the highest.

	Auditorium	Seminar Hall	Canteen	Administration Deptt.	Member Facilities I	Member Facilities II	Library
Auditorium	-	3	8	5	10	10	4
Seminar Hall	-	-	8	5	10	10	6
Canteen	-	-	-	9	2	2	1
Admn Deptt.	-	-	-	-	4	4	5
MemberFacilities I	-	-	-	-	-	9	8
MemberFacilities II	-	-	-	-	-	-	8

If the available area is 16 square units (4 units long and 4 units wide) and if each activity occupies 1 square unit, how best can the architect rearrange the layout of the building. Assume that all activities are required to be carried out in a single floor.

(b) Write short notes on :

(i) Route Card

(ii) Job enrichment.

Answer 8. (a)

The Total Closeness Ratings(TCR) for various activities are calculated as shown below:(using CORELAP procedure)

From\ To	Auditorium	Seminar Hall	Canteen	Admn Deptt.	Member Facilities I	Member Facilities II	Library	TCR
Auditorium	-	3	8	5	10	10	4	40
Seminar Hall	-	-	8	5	10	10	6	42
Canteen	-	-	-	9	2	2	1	30
Admn Deptt	-	-	-	-	4	4	5	32
MemberFacilities I	-	-	-	-	-	9	8	43
MemberFacilities II	-	-	-	-	-	-	8	43
Library								32

The activity with highest TCR is selected. These are Member Facilities I and Member Facilities II. Lets us take Member Facilities I. Two activities have highest rating with Member Facilities I : Auditorium and Seminar Hall. Amongst the two, Seminar Hall has higher TCR, therefore selected to be placed next to Member Facilities I. Auditorium has a rating of 10, so placed adjacent to Member Facilities I. Thus three activities have been assigned so far. Now, unassigned activity with highest rating with already assigned activities is Member Facilities II with Seminar Hall. Therefore Member Facilities II is assigned adjacent to

Seminar Hall. The 1st stage of layout so far arranged is as follows :

Seminar Hall	Member Facilities I
Member Facilities II	Auditorium

The procedure is repeated. The unassigned activity having highest rating with already assigned activity happens to be Library. Library is assigned next to Member Facilities I. Next Seminar Hall has a rating of 8 with Canteen. So Canteen is placed adjacent to Seminar Hall in the layout. The last round shows that Admn Deptt. Has a rating 9 with Canteen. Therefore Admn. is assigned next to Canteen. The Final layout is as follows :

Canteen	Admn. Deptt	
Seminar Hall	Member Facilities I	Library
Member Facilities II	Auditorium	

Answer 8. (b)

(i) Route card : A Route card is written statement indicating the route a component has to follow in sequence to ensure quality requirements as specified in the design.

The Route Card contains the following :

(I) The operation required and specified sequence of these operations:

(II) The Machines or Equipments to be used; and

(III) The estimated set-up time and runtime per piece.

For preparation of shop schedules, route sheet of all the components to be processed are used as master document. Route Card also act as travelling instruction sheets to inform the foreman and workers when and where to deliver the components for next operation and or inspection. Route Cards are prepared by Process Planning Engineers after due consideration of the capabilities and capacities of various machines, equipment and process. A lot of engineering inputs is required to prepare the Route Card as it becomes the ultimate reference document for processing a component of desired accuracy and quality.

(ii) Job Enrichment : It is monotonous to repeat the same tasks day after day throughout the working life of an employee. If there is no variety and change, the employee gets detached and frustrated. Job enrichment is a way of improving the job by adding more meaningful and skillful tasks from time to time to the existing tasks, thus making the job more satisfying to the employee. This will also make people multi-skilled and enhance the versatility of the employee, e.g. production workers may be asked to perform simple and routine maintenance activities or quality control activities.

Q. 9. (a) The demand for new double door refrigerators is increasing every year. This is thought to be related to increase in population of the urban areas. The relationship observed between the two is :

X= 7000 + 1100 Y, where X is the demand for new double door refrigerators, Y is the years with Y at 2007 being zero.

If the demand for new double door refrigerators is seasonal and indices for September, October and November are 1.30, 0.90 and 0.95, respectively, then

(i) Forecast the demand for new double door refrigerators in September 2012

(ii) Find the trend values (i.e, deseasonalised) for September 2013, and November 2013 and

(iii) Find estimates of demand for new double door refrigerators for October 2013.

(b) Differentiate between :

(i) Job Analysis and Value Analysis.

(ii) EOQ and BEP

Answer 9. (a)

(i) For 2012, Y = 5

Therefore, the expected demand during 2012:

X = 7000 + 1100(5) = 12500

Reasonable assumption is now made that demand for any year is centered on July 1. This is necessary in view of monthly forecasts asked for. The following figure shows that :

January 2012	June 15	July 15	January 2013
5 ½ months	1 month		5½ months

The mean (12500/12)=1042 would occur during June 15 to July 15, 2012. Applying the linear trend, the trend value of demand during July 15-Sept 1, 2012 (i.e for Aug. 2012) would be :

1042+ 3/2 (1100/12) = 1179.5

Similarly the trend value for succeeding month i.e for September 2012 is calculated as :

1179.5 + 1100/12 = 1271.1

Now applying seasonability(seasonal index for September is 1.30 :

1271.1 × 1.30 = 1652.4

The estimate of demand for September 2012 is 1652.4

(ii) The forecast of demand for year 2013 is :

X=7000+1100(6) = 13600

The trend values for September, October and November 2013 are found by a procedure similar to that followed in part (i) of this problem.

The mean (i.e. 13600/12=1133) would occur during the period June 15 to July 15, 2013. The trend value for July 15 to Sept. 1 is :

1133 + 3/2(1100/12) = 1270.5

The trend value for September 2013 (i.e September 1 to September 30) is :

1270.5 + (1100/12) = 1362.1

The trend values for October and November 2013 are :

October : 1362.1 + (1100/12) = 1453.7

November : 1362.1 + 2(1100/12) = 1545.3

(iii) Demand estimate for October 2013 is :

(Oct 2013 Trend value) × (Seasonal Index for Oct) = 1453.7 × 0.9 = 1308.3

Answer 9. (b) (i)

Job Analysis	Value Analysis
(a) Process of determining task components or work content of a job so as to access relative worth of different jobs.	Systematic application of established techniques to identify functions of product or component and to provide those functions at lowest possible cost.
(b) Technique of merit rating	Technique of cost reduction

(ii)

EOQ	BEP
(1) Optimum order quantity or lot size where total inventory costs (holding + carrying) are minimum.	Level of operations at which there is no profit or loss.
(2) EOQ is the lot size where two cost curves (holding &carrying) intersect each other.	BEP is point is the point where TCC and TRC intersect each other. It shows effect of fixed and variable costs, prices on profitability of an enterprise.
(3) Inventory control technique.	Helps management in capacity planning, product mix decisions, make or buy decisions, plant shutdown decisions etc.

Q. 10. (a) In ADG aircraft's landing gear assembly , defects of following natures were detected :

Aircraft No.	Number of Defects		
	Very Dangerous 'X'	Not so dangerous 'Y'	Minor 'Z'
1	-	-	5
2	-	1	4
3	-	1	-
4	1	-	2
5	-	2	1
6	-	-	3
7	-	-	3
8	-	-	9
9	-	1	6
10	-	-	1
11	1	-	3
12	-	-	1
13	-	2	-
14	-	4	2
15	-	-	-
16	-	1	4
17	-	1	6
18	1	1	3
19	-	-	4
20	-	-	2

The weightages given for different categories of de fects are : X: 10, Y :5, C: 1, Cons truct appropriate stabilized control chart /charts for quality.

(b) Explain the 'Operator Performance' scheme.

Answer 10. (a)

The weighted number of defects will be required to construct the control chart for defects. The table for number of defects can be reconstructed as follows:

Aircraft No.	Number of Defects
1	(5 × 1) = 5
2	(1 × 5) + (4 × 1) = 9
3	(1 × 5) = 5
4	(1 × 10) = 10
5	(2 × 5) + (1 × 1) = 11
6	(3 × 1) = 3
7	(3 × 1) = 3
8	(9 × 1) = 9
9	(1 × 5) + (6 × 1) = 11
10	(1 × 1) = 1

Aircraft No.	Number of Defects
11	(1 × 10) + (3 × 1) = 13
12	(1 × 1) = 1
13	(2 × 5) = 10
14	(4 × 5) + (2 × 1) = 22
15	0
16	(1 × 5) + (4 × 1) = 9
17	(1 × 5) + (6 × 1) = 11
18	(1 × 10) + (5 × 1) + (3 × 1) = 18
19	(4 × 1) = 4
20	(2 × 1) = 2

Total number of defects = 157

Average no. of defects per aircraft, c = 157/20 = 7.85

Standard deviation $(\sigma) = \sqrt{c} = 2.80$

The control limits for 'number of defects' chart or c-chart are:

$UCL = c + 3\sqrt{c} = 7.85 + 8.40 = 16.25$

$LCL = c - 3\sqrt{c} = 7.85 - 8.40 = 0$

(**Note :** Negative values are assigned zero)

It is observed that no. of defects for aircrafts 14 and 18 exceed UCL. Therefore these observations are deleted from analysis.

$$c = \frac{\text{Total no. of defects}}{\text{No. of observations}} = \frac{117}{18} = 6.5$$

$$\sqrt{c} = \sqrt{6.5} = 2.5$$

UCL = (6.5) + (3)(2.55) = 14.15

LCL = (6.5) – (3)(2.55) = 0

(**Note :** Negative values are assigned zero)

None of the given data crosses control limits. Thus last arrived control limits are stable control limits and control chart is as follows :

14.15 ———————— UCL

6.5 ———————— CL

0 ———————— LCL

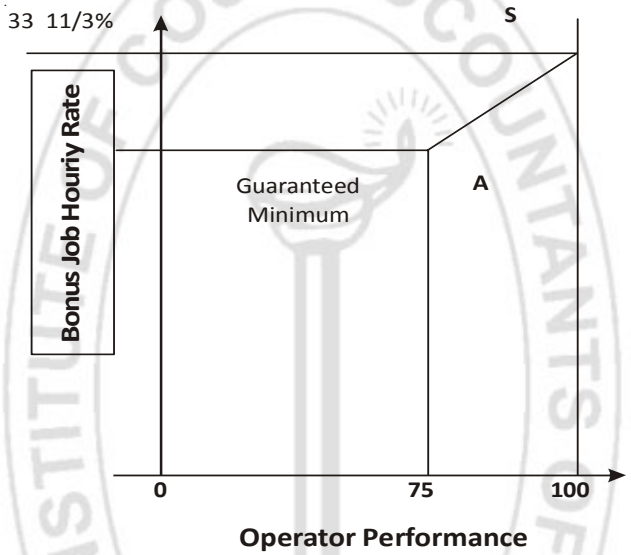
Answer 10. (b)

Work is measured by determining (with help of various techniques) the time it takes to do a job under given circumstances , when the worker is said to be working at standard rate of working. The time he takes to do the job is called 'Basic Time'. The basic Time(BT) for a job with the appropriate Relaxation Allowance(RA) added to it is called Standard Time(ST) expressed in standard minutes. If we consider these units in relation to the period associated with their production, we can establish an index of performance.

Thus, Performance Index(PI)= (Standard Minutes Produced/ Minutes taken to produce them)*100%

Thus, a representative operator working at Standard Rate of working and taking the appropriate amount of relaxation will achieve a PI of 100 over the working day or shift. This is known as 'Standard Performance.'

It is also important to develop a means of payment to reward such contribution adequately. In developing systems of bonus payments, it is necessary to establish a definite point for relating an appropriate amount of money to a particular increase in effort. It is generally agreed that such a point should be represented by the payment of a bonus equal to 1/3rd of the job hourly rate of Standard Performance. With this point established, it will be possible to develop a payment scale for all levels of performance- the ideal system of payment being one, where payment shall increase in direct proportion to increase in effort. Such a relationship is demonstrated in the following diagram.



It may be seen from the above diagram that incentive bonus is earned for all performances greater than 75%(shown as point A in the diagram.) For a performance of 100%(represented by point 'S' in the diagram), a bonus of $33\ ^1/_3$ % of wages is given. There are modifications made to the ideal graph shown alongside and in real practice, it is rare to find an real incentive scheme such as one described here.

Q. 11. (a) A machining centre in a job shop of a local fabrication company has five unprocessed jobs remaining at a particular point in time. The jobs are labeled 1, 2, 3, 4 and 5 in the order they enter the shop. The respective processing time and due dates are given in the time table below :

Job number	Processing time (days)	Due date
1	11	61
2	29	45
3	31	31
4	1	33
5	2	32

The production manager and the marketing manager of the job shop have different opinion on customer service. The production manager feels that for certain jobs delays are inevitable in the basic structure of the job shop working the loss as ₹ 50 per job per day of delay with respect to delivery date. The marketing manager feels delay would cost the organization ₹ 1000 per tardy job.

Examine the three commonest sequencing rules and state sequencing rule that would satisfy the organization requirement best.

(b) Draw a comparison between 'Type Grouping' and 'Sequence Grouping' of machines in a factory.

Answer 11. (a)

The three commonest rules of job sequencing are FCFS (First come first serve), SPT (Shortest possible time) and EDD (Earliest due date) basis.

Job Sequence	Processing time (day)	Completion time (day)	Due date(days)	Lateness (days)
FCFS basis				
1	11	11	61	-
2	29	40	45	-
3	31	71	31	40
4	1	72	33	39
5	2	74	32	42
Total				121
SPT basis				
4	1	1	33	-
5	2	3	32	-
1	11	14	61	-
2	29	43	45	-
3	31	74	31	43
Total				43
EDD				
3	31	31	31	-
5	2	33	32	1
4	1	34	33	1
2	29	63	45	18
1	11	74	61	13
Total				33

As per above calculations, results may be shown as :

Rule	No. of late jobs.	Lateness (days)	Average lateness (days)	Loss to the Company	
				As per P.M	As per M.M
FCFS	3	121	24.2	121×50 = 6050	3×1000 = 3000
SPT	1	43	8.6	43×50 = 2150	1×1000 = 1000
EDD	4	33	6.6	33×50 = 1650	4×1000 = 4000

As per P.M. EDD should be accepted, as per M.M SPT should be accepted. No single rule can satisfy both. However considering the no. of late jobs , SPT seems to have an edge.

Answer 11. (b)

The differences between Type and Sequence Grouping of machines are as follows :

Aspect	Type Grouping	Sequence Grouping
(1) Investment	Comparatively lower, due to higher capacity utilization.	Higher, as some machines in the line may remain partly utilized.
(2) Flexibility	Better in terms of processing new equipment.	Less flexibility in coping up with changes in the product or process.
(3) Breakdowns	Failure of machine doesnot stop production flow.	Breakdown of one machine disrupts flow and may stop the entire line.
(4) Throughput time.	Higher due to waiting time involved.	Lower.
(5) In process Inventory.	High	Low.
(6) Production Control	Difficult and needs continuous monitoring.	Simple.
(7) Supervision	High	Low
(8) Material movement	More often high due to criss-cross movements.	Material moves in predetermined routes and hence less movement.

Q. 12. (a) The main shaft of a scientific equipment has a very high reliability of 0.990. The equipment comes from Japan and has a high downtime cost associated with the failure of this shaft. This is estimated at ₹ 2 crores as the costs of sales lost and other relevant costs. However, this spare is quoted at ₹ 1lacs. at present. Should the shaft spare be procured along with the equipment and kept or not?

(b) The sprinklers used in irrigation generally become unusable due to soil sediments in water that get stuck in the system. F has studied the past data of failure of these sprinklers and has come up with findings as per Table below :

Time to Failure*	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
No. of failures	50	30	18	11	7	4	3	2	1

(Note: Sprinklers are repaired and installed to be as good as new)

(i) What is the mode of failure?

(ii) The MTTF (Mean Time To Failure)?

(iii) The mean rate of failure?

Answer 12. (a)

The expected cost of downtime = (Prob. Of failure) × (Cost when breakdown occurs)

= (1 – 0.990)(₹ 2 crores) = ₹ 2 lacs.

However, the cost of procuring the spare now is ₹ 10 lacs. Therefore, expected cost of downtime is less than the cost of the spare. Hence the spare need not be bought along with the equipment.

Answer 12. (b)

Failure of sprinklers is due to causes external to sprinklers, i.e due to sedimentation. So we would expect a negative exponential failure mode. This may be verified by rearranging the failure data as follows :

Time period (Week no.)	No. failing at the end of the period	No. surviving until the End of the Time Period.	Ratio of No. of failure to no. that had survived at the end of the period
1	50	126	50/126 = 0.3968
2	30	(126 – 50) = 76	30/76 = 0.3947
3	18	(76 – 30) = 46	18/46 = 0.3913
4	11	(46 – 18) = 28	11/28 = 0.3929
5	7	(28 – 11) = 17	7/17 = 0.4118
6	4	(17 – 7) = 10	4/10 = 0.4000
7	3	(10 – 4) = 6	3/6 = 0.5000
8	2	(6 – 3) = 3	2/3 = 0.6667
9	1	(3 – 2) = 1	1/1 = 1.0000
Total	126		

(**Note** : It is assumed that all failures occur at the end of the period and not in between)

MTTF is computed as follows :

Life in weeks	Fraction having this life
1	50/126
2	30/126
3	18/126
4	11/126
5	7/126
6	4/126
7	3/126
8	2/126
9	1/126

= (1*50/126)+(2*30/126)+(3*18/126)+(4*11/126)+(5*7/126)+(6*4/126)+(7*3/126)+(8*2/126)+(9*1/126)

= 0.3968+0.4761+0.4286+0.3492+0.2778+0.1905+0.1667+0.1270+0.0714

= 2.4841 weeks.

(c) ∴ Mean Rate of Failure = 1/MTTF

= 1/2.4841 = 0.4025 failure per week.

Q. 13. (a) Technology selection is very important in operations management. State, in brief, the various factors which influence the choice.

(b) A method engineering study of an assembly line of a product suggested installation of conveyors and fixtures involving a phased investment of ₹ 40 lacs. This resulted in five employees becoming redundant. The net monetary advantage, after provision for increased power and maintenance etc works out to ₹ 16 lacs per year. If the cost of the additional equipment is to be written off over a period of 8 years and the tax rate is 30%, is the method change worthwhile, if the company believes that any investment is worthwhile, only if it results in an after tax return of at least 35% on the average investment?

Answer 13. (a)

The choice of technology is a function of several factors- both internal and external. These are discussed below in brief :

Internal Factors :

(i) Availability of investible fund.

(ii) Product life cycle and technology life cycle –Usually at a matured stage or diffusion stage, looking for new technology and product is quite common. At this stage, choice of new technology becomes apparent.

(iii) Present plant capacity and technology involved- Since any new technology has finally to be absorbed and adapted to match company's objective condition, care must be taken to find out the ease of absorption and synergy effect.

External Factors :

(i) **Government policies and regulations** – Time to time Government announces its policies which have a direct bearing on the choice of technology. Thus when coal has been allowed to be imported, a Steel industry would like to import low ash content coal thereby influencing its technology choice.

(ii) **Availability of resources –** In line with Government policies , the availability of resources influences the technology choice to a great extent. Raw material, energy, skilled manpower, spares, natural and mineral resources- all these have strong bearing in choosing any technology.

(iii) **Market scenario** – It has two aspects. A company may choose a very sophisticated technology increasing its capacity to a great extent. However, if the market cannot absorb its output, there is no point on going for it.

Similarly, through various sources a company may come to know of a technology which otherwise has lots of potential and is very appropriate. Problem may be regarding its applicability. Depending on the risk-return disposition of the entrepreneur vis-à-vis scope of testing the capability of new technology, the choice will vary between new technology and proven technology.

Answer 13. (b)

Net monetary gain (incremental)	= ₹ 16 lacs p.a
Less, Depreciation(₹ 40 lacs/8)	= ₹ 5 lacs p.a
Incremental profit before tax	= ₹ 11 lacs p.a
Tax@ 30%	= ₹ 3.3 lacs p.a
Incremental profit after tax	= ₹ 7.70 lacs p.a

Total investment in phased manner = ₹ 40 lacs
Average investment = ₹ 40/2 lacs = ₹ 20 lacs.
Return on Investment (ROI) = (7.7/20*100)
= 38.5%

Since the return is more than the limit of 35%, the method change is worthwhile.

Note : Since monetary cost/ benefit of 5 employees is not discussed in the problem, same could not be take to consideration.

Q. 14. (a) The normal and crash duration with cost for various activities involved in a repair work is given below. The direct cost for supervision of the work is also indicated.

Activity	Time (days)		Cost (₹)		Expediting cost/(day) (₹)
	Normal	Crash	Normal	Crush	
1–2	6	2	4,000	12,000	2,000
1–3	8	3	3,000	6,000	600
2–4	7	4	2,800	4,000	400
3–4	12	8	9,000	11,000	500
4–6	3	1	10,000	13,000	1,500
5–6	5	2	4,900	7,000	700
3–5	7	3	1,800	5,000	800
5–7	11	5	6,600	12,000	900
5–7	10	6	4,000	8,400	1,100
Total			46,100	78,400	

The indirect cost of the project is ₹ 2,000 per day.

(i) Draw a network diagram for these activities indicating the earliest start and latest finishing time at each mode.

(ii) What is the normal and ultimate crash duration of the project?

(iii) Considering the effect of direct and Indirect cost, find the optimum project cost for a duration of 10 days.

(b) RX Pharmaceutical company produces two popular drugs P and Q which are sold at the rate of ₹ 9·60 and ₹ 7·80 respectively. The main ingredients are X. Y and Z and they are required in the following proportions :

The total available quantities (gms.) of different ingredients are 1,600 in X, 1,400 in Y and 1,200 in Z. The costs (₹) of X, Y and Z per gm. are ₹ 8, ₹ 6 and ₹ 4 respectively.

Drugs	X	Y	Z
A	50%	30%	20%
B	30%	30%	40%

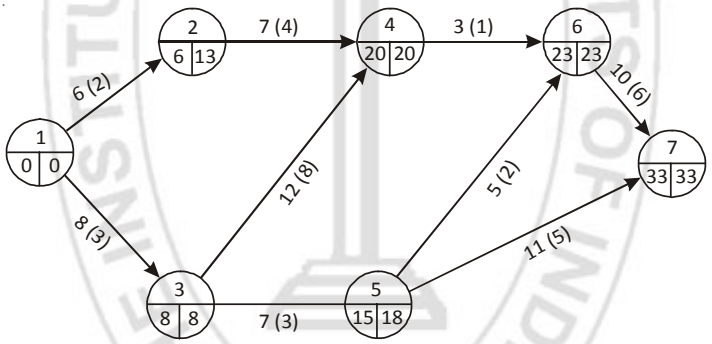
Estimate the most profitable quantities of P and Q to be produced, using the simplex method.

(c) A large engineering workshop has five shops. Hitherto, they have been fabricating five different types of components, *one in each shop*. Fabrication of one of the se components is t o be discontinued. Since the firm will follow the policy one shop-one component, one of the shops will be closed down. Data on the number of units to be manufactured and the unit costs are given below. Recommend an optimal plan as to which component should be produced in which shop and which of the shops be closed down. [Matrix elements are cost of fabrication in Rupees per unit].

		C1	*C2*	*C3*	*C4*
S	**SI**	**6**	**7**	**5**	**8**
H	**S2**	**7**	**6**	**5**	**9**
0	**S3**	**8**	**7**	**6**	**9**
P	**S4**	**8**	**9**	**4**	**8**
S	**S5**	**9**	**8**	**6**	**7**
Number of units	**(000)**	**8**	**6**	**4**	**5**

Answer 14. (a)

The network diagram is indicated below :



The critical path is 1—3—4—6—7.

Normal duration of project is 33 days.

Normal cost of completing the project within 33 days

= Direct cost + Indirect cost = 46,100 + 33 × 2,000 = ₹ 1,12,100

TABLE 1 : Crashing the Project

Crashing stage	Options	Possible crash (days)	Cost (₹)	Decision	Project duration	Ctitical path(s)
First	(i) 1—3	5	600			1—3—4—6—7
	(ii) 3—4	4	500	Crash 3—4 by 3 days	30	1—3—5—6—7
	(iii) 4—6	2	1,500			
	(iv) 6—7	4	1,100			
Second	(i) 1—3	5	600	Crash 1—3 by 4 days	26	1—3—4—6—7 1—3—5—6—7 1—2—4—6—7
Third	(i) 2—4, 1—3	1	1,000	Crash 2—4, 1—3 by 1 day	25	1—3—4—6—7 1—3—5—6—7 1—2—4—6—7
Fourth	(i) 6—7	4	1,100	Crash 6—7 by 4 days	21	1—3—4—6—7 1—3—5—6—7 1—2—4—6—7 1—3—5—7
Fifth	(i) 2—4, 3—4, 3—5	2	1,700	Crash 2—4, 3—4, 3—5 by 1 day	20	1—3—4—6—7
	(ii) 3—5, 4—6	2	2,300			1—3—5—6—7
	(iii) 5—7, 5—6 4—6	2	3,100			1—2—4—6—7 1—3—5—7
Sixth	(i) 5—6, 4—6, 5—7	2	3,100			1—3—4—6—7
	(ii) 3—5, 4—6	2	2,300	Crash 3—5, 4—6 by 2 days		1—3—5—6—7 1—2—4—6—7 1—3—5—7

TABLE 2 : Determination of Total Cost

Project duration (days)	Direct cost			Indirect cost	Total cost (₹)
	Normal	Crashing	Total		
33	46,100	0	46,100	33 × 2,000 = 66,000	1,12,100
30	46,100	1,500	47,600	60,000	1,07,600
26	46,100	3,900	50,000	52,000	1,02,000
25	46,100	4,900	51,000	50,000	1,01,000
21	46,100	9,300	55,400	42,000	97,400
20	46,100	11,000	57,100	40,000	97,100*
18	46,100	15,600	61,700	36,000	97,700

Remark : As per the question crashing should have been done upto 26 days in order to get the optimum cost on the 26the day (i.e. ₹ 1,02,000). But by further crashing cost can be further reduced till 20th day (₹ 97,100) beyond which the cost will rise. The cost at 20th day is the optimum project cost.

Answer 14. (b)

Profit/unit of P = 9·60 – {50% of ₹ 8 + 30% of ₹ 6 + 20% of ₹ 4}
= 9·60 - 6·60 = ₹ 3

Profit/unit of Q = 7·80 – {30% of ₹ 8 + 30% of ₹ 6 + 40% of ₹ 4}
= 7·80 – 5·80 = ₹ 2

Designating x_1 and x_2 as the number of units of drug P and drug Q to be produced. Then the appropriate mathematical formulation of the given problem as *L.P. model* is :

Maximize $Z = 3x_1 + 2x_2$

Subject to the constraints

$$0{\cdot}5x_1 + 0{\cdot}3x_2 \leq 1{,}600 \Rightarrow 5x_1 + 3x_2 \leq 16{,}000$$

$$0{\cdot}3x_1 + 0{\cdot}3x_2 \leq 1{,}400 \Rightarrow 3x_1 + 3x_2 \leq 14{,}000$$

$$0{\cdot}2x_1 + 0{\cdot}4x_2 \leq 1{,}200 \Rightarrow 2x_1 + 4x_2 \leq 12{,}000$$

$$x_1 \geq 0,\ x_1 \geq 0$$

Introducing slack variables s_1, s_2 and s_3 so as to convert the constraint inequalities into equations, the given problem can be restated as follows :

Maximize $Z = 3x_1 + 2x_2 + 0s_1 + 0x_1 + 0s_2 + 0s_3$

Subject to the constraints

$$5x_1 + 3x_2 + s_1 = 16{,}000$$

$$3x_1 + 3x_2 + s_2 = 14{,}000$$

$$2x_1 + 4x_2 + s_3 = 12{,}000$$

$$x_1 \geq 0, x_2 \geq 0, s_1 \geq 0, s_2 \geq 0, s_3 \geq 0$$

An initial basic feasible solution is :

$x_1 = 0$, $x_2 = 0$, $s_1 = 16{,}000$, $s_2 = 14{,}000$, $s_3 = 12{,}000$ at which $Z = 0$.

Starting with this solution, we obtain a sequence of simplex tableaus that leads to the optimal solution.

TABLE : FIRST, SECOND AND THIRD SIMPLEX TABLEAUS

		C_j	3	2	0	0	0	
C_B	Basic Variables **B**	Solution Values **b (= x_B)**	x_1	x_2	s_1	s_2	s_3	Min. Ratio
0	s_1	16,000	(5)	3	1	0	0	← 3,200
0	s_2	14,000	3	3	0	1	0	14,000/3
0	s_3	12,000	2	4	0	0	1	6,000
	Z_j	0	0	0	0	0	0	
	$C_j - Z_j$		3 ↑	2	0	0	0	
3	x_1	3,200	1	3/5	1/5	0	0	16,000/3
0	s_1	4,400	0	6/5	–3/5	1	0	11,000/3
0	s_2	5,600	0	(14/5)	–2/5	0	1	← 2,000
	Z_j	9,600	3	9/5	3/5	0	0	
	$C_j - Z_j$		0	1/5 ↑	–3/5	0	0	
3	x_1	2,000	1	0	2/7	0	–3/14	
0	s_1	2,000	0	0	–3/7	1	–3/7	
2	s_2	2,000	0	1	–1/7	0	5/14	
	Z_j	10,000	3	2	4/7	0	1/14	
	$C_j - Z_j$		0	0	–4/7	0	–1/14	

Since all $C_j - Z_j$ entries in the last table are zero or negative, optimal solution has been obtained, and the maximum value of Z is 10,000 which occurs when x_1 = 2,000 and x_1 = 2,000.

Answer 14. (c)

This is an Assignment Problem, since each shop will produce only one component.

Because the number of units of the components differ the total cost of fabrication has to be taken into account instead of just the unit cost. Total cost = Unit cost × No. of units.

Table of total cost shown below. Since there are five shops but only four components, a dummy component C5 [with 0 costs] has to be included to balance the AP. AP is for minimization of costs. Hungarian method will be used.

	C1	**C2**	**C3**	**C4**	**C5**
S1	48	42	20	40	0
S2	56	36	20	45	0
S3	64	42	24	45	0
S4	64	54	16	40	0
S5	72	48	24	35	0

Figures are total costs
No row reduction needed column
reduced matrix shown below

	C1	C2	C3	C4	C5	
S1	[0]	6	4	5	4	
S2	8	[0]	4	10	4	5 zeros assigned Solution
S3	16	6	8	10	[0]	optimal
S4	16	18	[0]	5	0	
S5	24	12		[0]	4	

Recommendations :

Shop	Component	Cost (₹ '000)	
S1	C1	48	
S2	C2	36	
S3	C5	0	Shop to be closed
S4	C3	16	down
S5	C4	35	
	Total cost	135	

Q. 15. (a) "Operations management includes conflict management as certain conflicts with other functional areas of management are inbuilt in operation function." Elaborate this and highlight some issues of conflict with managerial activity concerned with demand creation and demand satisfaction.

(b) The cost conscious company requires for the next month 300, 260 and 180 tonnes of stone chips for its three construction C_1, C_2 and C_3 respectively.

Stone chips are produced by the company at three mineral fields taken on short lease by the company. All the available boulders must be crushed into chips. Any excess chips over the demands at sites C_1, C_2 and C_3 will be sold ex-fields. The fields are M_1, M_2 and M_3 which will yield 250, 320 and 280 tonnes of stone chips respectively.

Transportation costs from mineral fields to construction sites vary according to distances, which are given below in monetary unit (MU) :

From \ To	C_1	C_2	C_3
M_1	8	7	6
M_2	5	4	9
M_3	7	5	5

(i) Determine the optimal economic transportation plan for the company and the overall transportation cost in MU.

(ii) What are the quantities to be sold from M_1, M_2 and M_3 respectively?

Answer 15. (a)

Demand creation and its satisfaction are the prerogative of the marketing department. The issues on which conflicts are observed between marketing and operation department may be highlighted below :

(i) **Planning of capacities :** Usually the production department would try to project a lower capacity not commensurate to sales requirement. For example, sales department may require a particular

finish for better market image while production department may show its inability. A group approach consisting of representatives of both the departments is required to determine the capacity to be utilized.

(ii) **Sales forecasts :** Sales is usually market driven and except in few core section industries (e.g steel, cement, paper etc) the market demand is not dependent upon production capacities. Accordingly at times, the market may not be in position to absorb the production, while at some other time demand may be booming pressuring the production to its limit. The balancing should be done at strategic and middle management level.

(iii) **Production plan :** Similar to above, the production department would like more of those products that call for less efforts on their part. This may not be what the market wants. Again the middle management intervention may be required to resolve the impasse.

(iv) **Product mix :** Like production plan, the product mix may not be in line with market requirement. Production department may not only like to determine the product mix but the size of the production as well. Middle management level intervention may again be necessary.

(v) **Quality control :** The sales department faces with clients as well as the production. Conflict arises when customers do not approve certain product while production department is reluctant to redo the job.

(vi) **Cost control :** Prices being market driven when level of technology used are more or less the same, cost competitiveness becomes the hall mark of survival. This is a sore point for production and marketing department. A budgetary approach in this regard would help particularly when representatives of both the departments are a part of the budget committee.

(vii) **Introduction of new product :** It is necessary for survival. However , production department gets geared to certain set pattern of production and do not like disturbance from routine. A gradual introduction through retraining may be tried to ease the process.

(viii) **Inventory levels :** Sales would like to have all products to be always ready in hand. This is particularly true in case of consumer products. However, production follows certain batch pattern. Unless the demand forecasts are done on scientific basis, this conflict would be perennial.

(ix) **Technical services including pre and post sales services :** Sales people require the help of production department in negotiation as well as for after sales service during warranty period. However, because of their commitment, sparing of production personnel may be difficult.

Depending on the nature of industry, this problem may be resolved by forming a separate gang for the purpose. For occasional requirement, however, administrative procedure may properly be framed so that no misunderstanding may crop up.

(x) **Availability of spare parts :** Sales people face the market. Naturally if the required spare parts are not available in the market they feel embarrassed. Unless the spare requirements are dovetailed into the programme, this problem gets manifested.

Answer 15. (b)

(i) **Using VAM, TP Tableau :**

		II	IV	I			
From \ To		C_1	C_2	C_3	Dummy	Supply	—
	M_1	8	7	6	0		6^x 1 1 1
				140	110	250	
III	M_2	5	4	9	0		4 1 5^x -
		300	20			320	

	II		IV		I		
To / From	C_1		C_2	C_3	Dummy	Supply	—
M_3	7		5 240	5 40	0	280	5 0 0 0
Reqd. →	300		260	180	110	850	
	2		1	1	0	* selected column/row	
	*2		1	1	-	I-IV order of	
	-		1	1	-	elimination of column/row	
	-		*2	1	-		

Since number of occupied cells = 6

and m + n – 1 is 6, VAM gives the IFS

Now, evaluation of unoccupied cells, using c – (m + v), will turn each of them (d_{ij}) + ve indicating that the IFS is the optimum solution.

Quantities to be transported

From	To	Tonnes × cost/tonne MU	Transport charges MU
M_1	C_3	140 × 6	840
M_2	C_1	300 × 5	1,500
	C_2	20 × 4	80
M_3	C_2	240 × 5	1,200
	C_3	40 × 5	200
		Total MU	3,820

(ii) Only, M_1 will have 110 tonnes net supplied to any of the construction sites, which will therefore, be sold ex-field.

Section II : Information Systems

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

(i) In the Windows System, a Folder is a storage area are :
- **(A) Files only**
- **(B) Folders only**
- **(C) Subfolders only**
- **(D) Files and subfolders only.**

(ii) A key-field implies :
- **(A) Important field**
- **(B) Sequence/search field**
- **(C) Alpha-numeric field**
- **(D) Only numeric field.**

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

(iv) For information recording the magnetic tape is divided into vertical columns called :
- **(A) Channels**
- **(B) Tracks**
- **(C) Frames**
- **(D) Grid.**

(v) Transistor Technology was used in which generation of Computers?
- **(A) First**
- **(B) Second**
- **(C) Third**
- **(D) Fourth**

(vi) CASE is :
- **(A) An operating system**
- **(B) A tool for software development**
- **(C) Displays web pages.**
- **(D) Not affected by power failure.**

(vii) Spooling is :
- **(A) A program being activated.**
- **(B) Communication between two pieces of hardware.**
- **(C) Buffer storage to reduce processing delays.**
- **(D) Identifies a particular device.**

(viii) Oracle is a software package for :

(A) MRP

(B) DBMS

(C) MIS

(D) TQM

(ix) OCR is :

(A) Input device

(B) Output device

(C) Processing device

(D) Storage device.

(x) 'COBIT' is :

(a) An operating system

(b) A publication of the ISACA

(c) Spreadsheet package

(d) Programming language.

Q. 16. (b) Complete the following sentences by putting an appropriate word in the blank position :

(i) A group of bits used to represent a symbol a symbol _____ .

(ii) _____ indicates a sequence of instructions that repeat until a predetermined count or other test is satisfied.

(iii) FAX stands for _____ .

(iv) Digital signature is the form of _____ function.

(v) A group of circuits interconnecting all sections of the microprocessor is called a _____ .

vi) Hybrid testing is also known as _____ testing.

(vii) SAPAG is a popular _____ package.

(viii) A symbol that marks to current position of the mouse on the screen or the point of entry of data is termed as _____ .

ix) _____ means browsing for information over the Internet.

(x) A _____ is a set of standards or rules.

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

(i) EUI

(ii) MOTIS

(iii) SMTP

(iv) RISC

(v) USART

(vi) VINES-

(vii) OOPS

(viii) DNS

(ix) VSAT

(x) B-ISDN

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

Column I	*Column II*
(i) Gateway	**(A) A program being activated.**
(ii) Iteration	**(B) Picture elements in individual dots.**
(iii) Invocation	**(C) Interconnecting two computer networks of different architure.**
(iv) Driver	**(D) Scrambling of Data.**
(v) Pixels	**(E) A website enabling users to access various level of information.**
(vi) Cache	**(F) Repetitive operation based on parameters.**
(vii) Encryption	**(G) Identifies a particulars device.**
(viii) Search Engine	**(H) First hypertext document that is displayed when the user follows a link to the web server**
(ix) Home Page	**(I) Output device**
(x) SVGA	**(J) High speed buffer memory.**

Answer 16. (a)

(i) (D) Files and subfolders only
(ii) (B) Sequence/search field
(iii) (A) HTML
(iv) (C) Frames
(v) (B) Second
(vi) (B) A tool for software development
(vii) (C) Buffer storage to reduce processing delays.
(viii) (B) DBMS
(ix) (A) Input device
(x) (B) A publication of the ISACA

Answer 16. (b)

(i) byte
(ii) loop
(iii) Facsimile
(iv) Hash
(v) bus
(vi) sandwitch
(vii) ERP
(viii) cursor
(ix) Surfing
(x) Protocol

Answer 16. (c)

(i) End User Interface.
(ii) Message oriented Text Interchange System.
(iii) Small Mail Transfer Protocol
(iv) Reduced Instruction Set Computing.
(v) Universal Synchronous /Asynchronous Receiver Transmitter.
(vi) Virtual Networking Software.
(vii) Object Oriented Programming System.
(viii) Domain Name System
(ix) Very Small Aperture Terminal.
(x) Broadband- Integrated Services Digital Network.

Answer 16. (d)

(i) — C
(ii) — F
(iii) — A
(iv) — G
(v) — B
(vi) — J
(vii) — D
(viii) — E
(ix) — H
(x) — I

Q. 17. (a) What is prototyping a system? Why is it becoming a popular me ans of system development today?

(b) Explain the role played by Finance Information System in making financial decisions.

(c) Explain the concept of system decomposition.

Answer 17. (a)

Prototyping is the process of quickly building model of the final software system. It is used as a communication total to assess and meet users' information needs.

Protyping follows three major ideas, viz.

(i) It builds a model,
(ii) it emphasizes users' involvement in system development, and
(iii) it attempts to develop systems which will ensure that they meet users' expectations.

Improvements in prototype are carried out with the aid of a prototyping software package, that create a series of displays on a VDU along with interfaces to be employed for various phases of data manipulation and the likely formats of the outputs.

Prototyping has become popular because of the following reasons :

(i) It attempts to obviate the common problem faced in developing systems that meet the users' expectations.

(ii) The narrative descriptions and diagrammatic techniques used by the computer professionals are not understood by the users.

(iii) For large software projects, it is an excellent means of communication between system developers.

(iv) Systems developed in traditional method often fails to represent what the users need.

(v) It saves time in system development by avoiding lengthy specification documentation.

(vi) Often it is possible to use the prototype itself as the final system and thus the system can be operational quickly.

Answer 17. (b)

Financial Information System plays an important role in making following financial decisions:

(i) **Estimation of r equirements of funds :** This is the very important and starting point of making financial decisions. A very careful estimation of funds and the time at which these funds are required is made in this stage. This can be done by forecasting all physical activities of the firm and translating them into monetary units.

(ii) **Capital structure decisions :** Decisions are to be taken to select an optimum mix of different sources of capital structure. There are many options available for procuring funds. Decision maker has to decide the ratio between debt and equity, long-term and short-term funds etc. He has to ensure that overall capital structure is such that the company is able to procure funds at optimum cost.

(iii) **Capital budgeting decisions :** Funds procured from various sources are required to be invested in different assets. With the help of capital budgeting, decision maker can determine feasibility of investment in long-term assets. This will help in attainment of financial objectives.

(iv) **Profit p lanning :** This part of profit planning is essential for the growth of the organization. The decision maker has to make decision regarding profits and dividends. He has to ensure adequate surplus in future for growth and distribution of dividends.

(v) **Tax management :** Tax planning is aimed at reducing of outflow of cash resources by way of taxes so that the same may be effectively utilized for the benefit of business. The purpose of tax planning is to take full advantage of exemptions, deductions, concessions, rebates, allowances and other relief.

(vi) **Working capital management :** Working capital management is concerned with the investment of long term funds into current assets. Decisions are to be taken for effective financing of current assets required for day-to-day running of the organization.

(vii) **Current assets management :** Policy decisions are taken regarding various items of current assets. Credit policy determines the amount of sundry debtors at any point of time. Inventory policy is to be determined jointly between finance and production department.

Answer 17. (c)

A computer system is difficult to comprehend when considered as a whole. Therefore, it is better that the system is decomposed or factored into sub systems. The boundaries and interfaces are defined, so that sum of the sub systems constitutes the entire system. This process of decomposition is continued with sub systems divided into smaller sub systems until the smallest sub systems are of manageable size. The sub systems resulting from this process generally form hierarchical structure.

Q. 18. (a) What do you understand by 'memory dump'? What number systems are used for such purpose and which one is easier to work with?

(b) Distinguish between :

(i) Fixed length field and Variable length field (with reference to database).

(ii) Syntax error and Logical error.

(iii) Analog computer and Digital computer.

(c) Write short note on programmed decisions.

Answer 18. (a)

'Memory dump' means taking a printout of the binary contents or raw data in the computer memory. There are several occasions when the computer professionals require such a 'memory dump'.

Windows can generate any one of the following memory dump file types :

- Complete memory dump
- Kernel memory dump
- Small memory dump (64 KB)

Number System that are commonly used as short cut notation for binary are Octal hexadecimal system. If memory dump is taken in binary, huge quantity of print out will be necessary with only two variations, i.e 0 and 1. It is easier to work out with the octal and hexadecimal system, which reduces the print out to a large extent.

Answer 18. (b)

(i)

Fixed length field	Variable length field
Under Fixed Length Fields scheme, fields are simply placed in sequence one after another. Thus, while designing physical records, it conserves storage space. In this scheme, a trailing blank pad character field and leading zero pad numeric field is used. Hence, under fixed length field scheme we know the exact location within a file for each of the fields of a physical record.	Variable Length Fields scheme makes the location of a particular field and a particular record irregular. That is, depending on which records exist and the precise values for fields, different records and fields will be in different locations. A common way to handle variable length field is to break the relation into a fixed length physical records containing all fixed length fields and one or more variable length physical records. In personal computers, this is how many DBMS handle a memo field which is a variable-length field.

(ii)

Syntax error	Logical error
Syntax error is a mistake in instruction or use of a programming language detected during compilation of a program and response is indicated by the operating system in the form of an output. Such mistakes may be a spelling mistake or use of wrong word or wrong sequence or a deviation from the defined usage of the programming language.	Logical error arises from wrong reasoning or faulty programming logic, eg. Trying to execute invalid data with invalid instruction or forming an unending loop, etc.

(ii)

Analog computer	Digital computer
Analog computers process data input in a continuous form. Data such as voltage, resistance or temperature and pressure etc. are represented in a computer as a continuous, unbroken flow of information. In engineering and scientific applications where quantities to be processed exist in wave forms or continually rising and falling voltages, pressure and so on, analog computers are very useful.	Digital computers, on the other hand, count and accept letters or numbers through various input devices that convert the data into electric pulses, and perform arithmetic operations on numbers in discrete form. In addition to performing arithmetic operations, they are also capable of storing data for processing, performing logical operations, editing or deleting the input data and printing out the result of its processed routine at high speed.

Answer 18. (c)

Programmed Decisions : Such decision procedures are applicable to situations and problems which are routinely recurring, are more familiar and can be structured. Programmed decisions have built-in pre-decided rules or procedures which are well-structured in advance and are time tested for their validity. Thus, programmed decisions are said to refer to decisions made on problems and situations by reference to a predetermined set of precedents, procedures, techniques and rules. As a consequence, by applying these rules to a problem, a decision emerges. Manager's judgment or discretion is not required. Thus, decision making is simplified.

Organizations evolve a repertory of procedures, rules, processes and techniques for handling routine and recurring problem situations. For example, for many organizations there is a set procedure for receipt of materials, payment of bills etc. These are examples of programmed decisions which tend to be consistent over situations and time.

Q. 19. (a) Discuss briefly the reasons as to why the organizations fail to achieve their System Development Objectives?

(b) Describe briefly four categories of the major tools that are used for system development.

(c) What do you understand by the term 'Data Dictionary'?

Answer 19. (a)

Following are some of the reasons due to which the organisations fail to achieve their system development objectives :

(i) **Lack of senior management support for and involvement in information system development :** In the management of information systems, developers and users depend on the senior management for support and to determine which systems development projects are important. Their tendency is to shift away from the project, which lack senior management attention.

(ii) **Shifting user needs :** User requirements for information technology are constantly varying. As these changes accelerate, there will be more requests for systems development and more development projects. When these changes occur during a development process, the development team may be faced with the challenge of developing systems whose very purposes have changed since the development process began.

(iii) **Development of s trategic s ystems :** Because strategic decision-making is unstructured, the requirements, specifications and objectives for such development projects are difficult to define and determining successful development will be elusive.

(iv) **New technologies :** New technologies are coming in the organizations want to apply these and create a competitive situation. However, later they find that attaining systems development objectives is more difficult because personnel are not familiar with the new technology.

(v) **Lack of standard project management and systems development methodologies :** Some organizations do not formalize their project management and systems development methodologies, thereby making it very difficult to consistently complete projects on time or within the budget.

(vi) **Overworked or under-trained development staff :** It is generally established that there is backlog of systems development work due to lack of efficient staff. In addition to being overworked, system developers often lack sufficient educational background. Many companies do little to help their development personnel stay technically updated and in these organizations, a training plan and training budget do not exist.

(vii) **Resistance to change :** People have a natural tendency to resist change, and information systems development projects signal changes – often radical – in the work place. Business process reengineering is often the catalyst for the systems development project. When personnel perceive that the project will result in personnel cutbacks, threatened personnel will dig in their heels, and the development project is doomed to failure. Personnel cutbacks often result when reengineering projects really attempt at downsizing (or right sizing).

(viii) **Lack of user participation :** Users must participate in the development effort to define their requirements, feel ownership for project success, and work to resolve development problems. User-participation also helps reduce user resistance to change.

(ix) **Inadequate testing and user training :** New systems must be tested before installation to determine that they will operate correctly. Users must be trained to effectively utilize the new system. By executing the system development process efficiently and effectively, the above problem can be solved.

Answer 19. (b)

The major tools used for system development can be grouped into four categories based on the systems features each document has. These are:

(i) Components and flows of a system

(ii) User interface

(iii) Data attributes and relationships

(iv) Detailed system process.

Each of these categories are briefly discussed below :

(i) **System components and flows :** For system analysts these tools are helpful to document the data flow among the major resources and activities of an information system. System flow charts are typically used to show the flow of data media as they are processed by the hardware devices and manual activities. A system component matrix provides a matrix framework to document the resources used, the activities performed and the information produced by information system. A data flow diagram uses a few simple symbols to illustrate the flow of data among external entities.

(ii) **User interface :** Designing the interface between end users and the computer system is a major consideration of system analysts while designing the new system. Layout forms and screens are used to construct the formats and contents of input / output media and methods. Dialogue flow diagrams analyze the flow of dialogue between computers and people. They document the flows among different display screens generated by alternative end user responses to menus and prompts.

(iii) **Data attributes and relationships :** These tools are helpful to define, catalogue and design the data resources in information systems. A data dictionary catalogs the description of the attributes of all

data elements and their relationship to each other as well as to external systems. Entity – relationship diagrams are also used to document the number and type of relationship among the entities in a system. File layout forms document the type, size, and names of the data elements in a system. Grid charts help in identifying the use of each type of data element in input / output or storage media of a system.

(iv) **Detailed system process :** These tools are used to help the programmer to develop detailed procedures and processes required in the design of a computer program. Decision trees and decision tables use a network or a tabular form to document the complex conditional logic involved in choosing among the information processing alternatives in a system. Structure charts document the purpose, structure and hierarchical relationships of the modules in a program.

Answer 19. (c)

Data Dictionary: It is a computer file that contains descriptive information about the data items in the files of a business information system. In other words, it is a computer file about data. The information included in each record of a Data Dictionary may include the following about an item :

(i) Codes describing the data item's length, data type and range.

(ii) Identity of the source documents used to create the data.

(iii) Names of the computer files storing the data item.

(iv) Identity of individuals/programs permitted to access the data item for the purpose of file maintenance, upkeep or inquiry.

(v) Identity of programs/individuals not permitted to access the data item.

(vi) Names of the computer programs that modify the data item.

It has variety of uses. It serves as an aid to documentation and is also useful for securities. It helps accountants and auditors in establishing audit trails and in planning the flow of transaction data through the system. Finally, it serves as an important aid in investigating or documenting internal control procedures.

Q. 20. (a) Discuss the effect of applying computer technology to Management Information System.

(b) What are the limitation of the Management Information System.

Answer 20. (a)

The effects of applying computer technology to Information System are as discussed below :

(i) **Speed of processing and retrieval of data increases :** Modern business situations invariably call for systems capable of providing relevant information with minimal loss of time. Manual system, howsoever well organized, often fails to match the demand for information for decision-making. Computer with its unbelievably 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. The speed of computer processing is in new range i.e. an operation takes only billionths of a second. This characteristic of computer has accounted for as a major factor in inducing MIS development.

(ii) **Scope of use of information system has expanded :** The importance and utility of information systems was realized by most of the business organizations after the induction of computers for MIS development. System experts in business organizations developed 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. For example, online systems can provide information to various users sitting at a remote distance from a centrally located computer system.

(iii) **Scope of analysis widened :** The use of computer can provide multiple type of information accurately and in no time to decision makers. Such information equips an executive to carry out a thorough

analysis of the problems and to arrive at the final decision. Computer is capable of providing various types of sales reports, which are useful in analyzing the sales department working and to ascertain their weakness so that adequate measures may be taken in time.

(iv) **Complexity of system design and operation increased :** After the inclusion of computer for MIS development, system experts faced problems in designing system and their operations because of the non availability of experts in the initial stage. But in the present situation, the computer manufacturers have developed some important programs (software) to help their users. Also, private agencies are there to develop programs to cater to the specified needs of their customers either on consultancy basis or on contract.

(v) **Integrates the working of different information subsystem :** There are number of subsystems like production, material, marketing, finance, engineering and personnel which constitute MIS. Each of these sub systems are required to provide information to support operational control, management control and strategic planning. Such information may be available from a common data base which meets the information requirements of different information sub system by utilizing the services of computers for storage, processing, analyzing and providing such information as and when required.

(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.

Answer 20. (b)

Limitations of the Management Information System :

(i) MIS is not a substitute for effective management. It cannot replace managerial judgement in making decisions in different functional areas.

(ii) MIS may not have requisite flexibility to quickly update itself with changing needs of time.

(iii) MIS cannot provide tailor-made information packages suitable for the purpose of every type of decision made by executives.

(iv) MIS takes into account mainly quantitative factors, thus it ignores the non-quantitative factors like morale and attitude of members of the organization.

(v) MIS is less useful for making non-programmed decisions.

(vi) The effectiveness of MIS decreases due to frequent changes in top managements, organisational structure and operational team.

(vii) MIS effectiveness is reduced where culture of hoarding information and not sharing with others exists. The quality of the outputs of MIS is basically governed by the quality of input and processes.

Q. 21. (a) "A decision support system supports the human decision-making process rather than providing a means to replace it". Justify the above statement by stating the characteristics of decision support system.

(b) Describe various software tools used in Decision support system.

(c) What are the four basic components of decision support system?

Answer 21. (a)

A decision support system (DSS) is defined as a system that provides tools to managers to assist them in solving semi structured and unstructured problems in their own way. A DSS is not intended to make decisions for managers, but rather to provide managers with a set of capabilities that enables them to

generate the information required by them in making decisions. The DSS are characterized by following three properties:

(i) **Semi-structured / Unstructured decisions** – Structured decisions are those that are easily made from a given set of inputs. Unstructured decisions and semi-structured decisions are decisions for which information obtained from a computer system is only a portion of the total knowledge needed to make the decision. The DSS is particularly well adapted to help with semi-structured / unstructured decisions. In DSS, the problem is first defined and formulated. It is then modeled with DSS software. The model is run on the computer to provide results. The modeler, in reviewing these results, might decide to completely reformulate the problem, refine the model, or use the model to obtain other results.

(ii) **Ability to adapt to changing need** – Semi-structured / unstructured decisions often do not conform to a predefined set of decisions-making rules. Because of this, their decision support system must provide for enough flexibility to enable users to model their own information needs. The DSS designer understands that managers usually do not know in advance what information they need and, even if they do, those information needs keep changing constantly. Thus, rather than locking the system into rigid information producing requirements, capabilities and tools are provided by DSS to enable users to meet their own output needs.

(iii) **Ease of Learning and Use** – Since decision support systems are often built and operated by users rather than by computer professionals, the tools that company possesses should be relatively easy to learn and use. Such software tools employ user-oriented interfaces such as grid, graphics, non-procedural 4GL and easily read documentation. These interfaces make it easier for user to conceptualize and perform the decision making process.

Answer 21. (b)

Software tools of DSS : Decision support system includes a variety of software supporting database query, modeling, data analysis and display. These tools fall under following four categories :

(i) **Database languages :** Tools supporting database query and report generation use mainframe, mini computer and microcomputer based databases. FOCUS, RAMIS and NOMAD II are mainframe based languages supporting data base query, report generation and analysis. FOCUS, RAMIS are also available in PC version. MS Access is one of the most popular database query package used in Window based PC.

(ii) **Model based Software :** Model based analysis tools such as spreadsheet software enable manager to design models that incorporate business rules and assumptions. Lotussuits and MS-Excel supports model building and "what if" type analysis. Modeling tools like IFPS are designed to support financial modeling and analysis.

(iii) **Statistics and Data Manipulation tools :** Statistical analysis software such as SAS, SPSSS supports market researchers, operation research analysts and other professionals using statistical analysis functions and are generally used on mainframe computers. Microcomputer-based statistical packages are available as well.

(iv) **Display based DSS :** Graphic displays of output generated from MS-Excel are very effective in management presentation. Graphics tools running in a mainframe environment include DISSPLA, TELLAGRAF and SASGRAPH. Microcomputer based tools such as Harward Graphics, and Power Point display output in the form of pie charts, bar charts and graphs.

An integrated module of MS-Excel and Power-Point that provides the ability to generate, manipulate and statistically analyze data is best example of query, modeling and display software .

Answer 21. (c)

A decision support system has the following components :

(i) **The User :** The user of a decision support system is usually a manager with an unstructured or semi-structured problem to solve. Users do not need a computer background to use a decision support system for problem solving. The most important knowledge is a thorough understanding of the problem and the factors to be considered in finding a solution. A user does not need extensive education in computer programming in part because a special planning language performs the communication function within the decision support system.

(ii) **One or more databases :** Decision support systems include one or more databases which contain both routine and non-routine data from both internal and external sources. The data from external sources include data about the operating environment surrounding an organization. Decision support system users may construct additional database themselves. Some of the data may come from internal source.

(iii) **A planning language :** Two types of planning languages that are commonly used in decision support system are (1) general purpose planning languages and (2) special purpose planning languages. General purpose planning languages allow users to perform many routine tasks like-retrieving various data from a database or performing statistical analysis. The languages in most electronic spreadsheets are good example of general purpose planning languages. These languages enable the user to tackle a broad range of budgeting, forecasting and other worksheet oriented problems. Special purpose planning languages are more limited. Some statistical languages, such as SAS, SPSS and Minitab are examples of special purpose planning languages.

(iv) **Model Base :** The model base is the "brain" of the decision support system because it performs data manipulation and computations with the data provided to it by the user and the database. There are many types of model bases but most of them are custom-developed models that do some type of mathematical functions. The analysis provided by the routine in the model base is the key to supporting the user's decision.

Q. 22. (a) "The final step of the system implementation is its evaluation." What functions are being served by the system evaluation? Discuss development, operation and information evaluations.

(b) Differentiate between 'Scheduled maintenance' and 'Rescue maintenance' along with their respective benefits with respect to Information Systems.

Answer 22. (a)

The final step of the system implementation is evaluation. Evaluation provides the feedback necessary to assess the value of information and the performance of personnel and technology included in the newly designed system. This feedback serves two functions :

1. It provides information as to what adjustments to the information system may be necessary.
2. It provides information as to what adjustments should be made in approaching future information system development projects.

There are two basic dimensions of information systems that should be evaluated. The first dimension is concerned with whether the newly developed system is operating properly. The other dimension is concerned with whether the user is satisfied with the information system with regard to the reports supplied by it.

(i) **Development evaluation :** Evaluation of the development process is primarily concerned with whether the system was developed on schedule and within budget. This is a rather straightforward evaluation. It requires schedules and budgets to be established in advance and that record of actual performance and cost be maintained. It may be noted that very few information systems have been

developed on schedule and within budget. In fact, many information systems are developed without clearly defined schedules or budgets. Due to the uncertainty and mystique associated with system development, they are not subjected to traditional management control procedures.

(ii) **Operation evaluation :** The evaluation of the information system's operation pertains to whether the hardware, software and personnel are capable to perform their duties and they do actually perform them so. Operation evaluation answers such questions :

1. Are all transactions processed on time?
2. Are all values computed accurately?
3. Is the system easy to work with and understand?
4. Is terminal response time within acceptable limits?
5. Are reports processed on time?
6. Is there adequate storage capacity for data?

Operation evaluation is relatively straightforward if evaluation criteria are established in advance. For example, if the systems analyst lays down the criterion that a system which is capable of supporting one hundred terminals should give response time of less than two seconds, evaluation of this aspect of system operation can be done easily after the system becomes operational.

(iii) **Information evaluation :** An information system should also be evaluated in terms of information it provides. This aspect of system evaluation is difficult and it cannot be conducted in a quantitative manner, as is the case with development and operation evaluations. The objective of an information system is to provide information to support the organizational decision system. Therefore, the extent to which information provided by the system is supportive to decision making is the area of concern in evaluating the system. However, it is practically impossible to directly evaluate an information system's support for decision-making in an organisation. It must be measured indirectly. User satisfaction can be used as a measure to evaluate the information provided by an information system. Measurement of user satisfaction can be accomplished using the interview and questionnaire technique. If management is generally satisfied with an information system, it is assumed that the system is meeting the requirements of the organization. If management is not satisfied, modifications ranging from minor adjustments to complete redesign may be required.

Answer 22. (b)

Most information systems need some modifications after development. This need arises from time to time, due to failures to anticipate all requirements during system design and/or due to changed organisational needs. The changing needs impact most information systems and thus regular systems maintenance involves adding new data elements, modifying reports, adding new reports, changing calculations etc.

Such maintenance can be categorised in the following two ways:

(i) Scheduled Maintenance is undertaken for tasks which can be anticipated and can be planned for in advance. An information system may remain in an operational and maintenance mode for several years. The system should be evaluated periodically to ensure that it is operating properly and is still workable for the organisation.

(ii) Rescue maintenance refers to previously undetected malfunctions or such sudden changes that were not anticipated but require immediate solution. A system that is properly developed and tested should have few occasions of rescue maintenance. Rescue maintenance is unplanned and generally puts system stand still.

Q. 23. (a) What is an application software?

(b) Discuss the factors upon which "Make or Buy" decision of an application software depends.

(c) Outline the steps involved in selection of a computer system.

Answer 23. (a)

Application software is aimed at a solution to a particular problem of the user of a computer system. It has direct interface with the computer system and provides standard processing utilities to solve the specific application problems of the user. For example, number of application software exists in the area of accounting and financial management.

Application software can be sub-divided into two categories viz. general-purpose and application-specific. General-purpose application software are programs that perform common information processing jobs for end users such as word processing programs, spreadsheet programs and database management programs etc. Application specific programs support specific applications of end users e.g. accounting package, inventory control, scientific analysis, computer assisted instruction programs in education etc.

Answer 23. (b)

Factors affecting the "make or buy" decision of application software are as follows:

- **Availability of skilled manpower :** If sufficient number of programmers is not available, the organization may be forced to purchase packages that it otherwise would develop.
- **Cost of programming :** In case the cost of developing the software is more than the price of pre-written software, the organization may decide to buy the software.
- **Backlog of program :** The in-house software development takes long time. If there is lot of backlog of programs awaiting development, the organization may choose to buy the software.
- **Suitability of software :** Sometimes the available software may not be suitable for specific needs of the organization. Hence, it may be better to develop software in such instances.
- **Time frame available for implementation :** If the time available for implementation of the new computerized system is very short, the organization may decide to buy the software.
- **Availability of sophisticated software :** In many instances, the programs available for purchase are more sophisticated than the organization would probably develop. For example, many of the applications programs are fully integrated with other application programs. This integration is a powerful incentive for purchasing rather than developing programs.

Answer 23. (c)

Steps involved in selection of a computer system :

- Prepare the design specifications.
- Prepare and distribute an RFP (Request for proposal) to selected computer vendors.
- On the basis of analysis of proposals, eliminate vendors whose proposals are inferior.
- Have vendors present their proposals.
- Conduct further analysis of the proposals.
- Contact present users of the proposed system.
- Conduct equipment benchmark tests.
- Select the equipment.

Q. 24. (a) Give one or two reasons for each of the following:

(i) Need of modem in data communication

(ii) Use of Gateway in computer network

(iii) Use of Router

(iv) Protocol Translator

(b) Explain the various functions of communications software.

(c) Describe the benefits of SAN.

Answer 24. (a)

(i) Modem stands for modulator/demodulator. It is a device that converts a digital computer signal into analog telephone signal or vice versa. Modems are required to tele-communicate computer data with ordinary telephone lines because computer data is in digital form but telephone lines are analog.

(ii) Gateways are usually used to link LANs of different topologies, e.g., Ethernet and Token ring for enabling the exchange of data. They do not possess the management facilities of routers but like routers they can translate data from one protocol to another.

(iii) Router is a special purpose computer or software package that handles the connection between two or more networks. Routers spend all their time looking at the destination addresses of the packets passing through them and deciding on which route the packets should be sent.

(iv) It is a peripheral device which converts the communication protocol of one system into the protocol of another system so that the two systems are compatible enabling data to be transferred between them.

Answer 24. (b)

Communications software manages the flow of data across a network. It performs the following functions :

(i) **Access control :** Linking and disconnecting the different devices, automatically dialing and answering telephones; restricting access to authorized users; and establishing parameters such as speed, mode and direction of transmission.

(ii) **Network management :** Polling devices to see whether they are ready to send or receive data; queuing input and output; determining system priorities; routing messages, and logging network activity, use and errors etc.

(iii) **Data and file transmission :** Controlling the transfer of data, files and messages among the various devices.

(iv) **Error detection and control :** Ensuring that the data sent was indeed the data received.

(v) **Data security :** Protecting data during transmission from unauthorized access.

Answer 23. (c)

A Storage Area Network (SAN) is a dedicated, centrally managed, secure information infrastructure, which enables any-to-any interconnection of servers and storage systems. Following are the benefits of SAN :

(i) **Removes data traffic :** Like back up processes, from the production network giving IT managers a strategic way to improve system performance and application availability.

(ii) **Improves data access :** Using fiber Channel connections, SAN provides high speed network communication and distance needed by remote workstations and servers to easily access shared data storage pools.

(iii) **Centralized Management of Data :** IT managers can more easily centralize the management of their storage systems and consolidate backups, increasing overall system efficiency. The increased distances provided by Fiber Channel Technology makes it easier to deploy remote disaster recovery sites. Fiber Channel and switched fabric technology eliminate single point of failure on the network.

(iv) **Unlimited network expansion :** Unlimited expansion is possible with hubs and switches. Nodes can be removed or added with minimal disruption to the network.

Q. 25. (a) What are the important decisions, which influence the physical design of a database? Discuss.

(b) Explain the terms-

(i) Data Quality

(ii) Data Mart.

(c) Write short notes on :

(i) Teleconferencing

(ii) Voice Messaging

Answer 25. (a)

Physical database design requires several critical decisions that will affect the integrity and performance of the application system. These key decisions include the following :

(i) Choosing the storage format called data-type for each attribute from the logical data model. The format is chosen to minimize storage space and to maximize data integrity.

(ii) Grouping attributes from the logical data model into physical records.

(iii) Arranging similarly structured records in secondary memory (primary hard disks) so that individual and groups of records (called file organizations) can be stored, retrieved and updated rapidly. Consideration may also be given to protect data and recovering data after errors are found.

(iv) Selecting structures (called indexes and database architectures) for storing and connecting files to make retrieval of related data more efficient.

(v) Preparing strategies for handling queries against the database that will optimize performance and take advantage of the file organizations and indexes that the users have specified. Efficient database structures will be of benefit only if queries and the database management systems that handle those queries are tuned intelligently to use those structures.

Answer 25. (b)

(i) Quality of data is the most important aspect as far as its use is concerned. The classic expression on the importance of quality of data for data processing is represented by the word 'GIGO' – Garbage In Garbage Out. This word was devised to forewarn the systems people to be all careful for ensuring quality of data for the success of an information system. The poor quality of data means incorrect, incomplete and ambiguous data. A poor quality data may cause great damage in reporting and action initiated by it. The aim of good quality of data is to provide information which must have these quality :

- Relevance
- Timeliness
- Accuracy
- Completeness
- Consciousness
- Understandability

(ii) Data mart is the 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. For example, data marts may be created for marketing

department with competitors information only to develop business strategy to improve market share. This kind of approach is meaningful as far as relevant information base is required. Instead of waiting for comprehensive data warehousing, data mart sometimes provide tremendous services to meet immediate and specific information need.

Answer 25. (c)

(i) Teleconferencing refers to electronic meeting that involves people who are at physically different sites. Telecommunication technology allows members of the meeting to interact with one another without traveling to the same location. Three types of teleconferencing namely audio teleconferencing, video teleconferencing and computer teleconferencing exist.

Audio Teleconferencing is the use of voice communication equipments to establish an audio link between geographically dispersed persons and to conduct a conference. This does not require a computer but requires two-way communication facilities. Video conferencing is the use of television equipments to link geographically dispersed participants. Equipment provides both sound and picture. With this conferencing participants can see and hear each other. Lastly, computer conferencing is the use of networked computers that allow participants with some common characteristics to exchange information concerning a particular topic. A computer conference group can consist of large number of participants and it can be used within a single geographic site.

(ii) Voice Messaging approach is similar to Electronic mail except in this approach, audio messages rather than text messages are processed. A sender speaks on the phone giving the name of the recipient and message. Sender's voice signals are converted to digital signals and stored. The system then transfers the message to the recipient. The message is converted back to analog form when it is received by the recipient. Recipient hears the same voice as it had been spoken by the sender. Voice messaging requires a computer with the ability to store the message by converting it into digital form and converting back to analog form upon retrieval. Main advantage of voice messaging over electronic mail is that the sender need not have to type the message.

Q. 26. (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 26. (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.

Answer 26. (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 organisational 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.

Q. 27. (a) Describe the various security components available in a Secure Operating system.

(b) What are the subversive threats? How do the intruders manipulate the messages being transmitted?

Answer 27. (a)

Operating system security involves policy, procedures and controls that determine who can access the operating system, which resources they can access, and what actions they can take. The following security components are found in secure operating system :

(i) **Log-on Procedure :** A log-on procedure is the first line of defence against unauthorised access. When the user initiates the log-on process by entering user id and password, the system compares the ID and password to a database of valid users. If the system finds a match, then log-on attempt is authorised. If password or ID is entered incorrectly, then after a specified number of attempts, the system should lock out the user from the system.

(ii) **Access token :** If the log on attempt is successful, the OS creates an access token that contains key information about the user including user ID, password, user group and privileges granted to the user. The information in the access token is used to approve all actions attempted by the user during the session.

(iii) **Access control list :** This list contains information that defines the access privileges for all valid users of the resource. When a user attempts to access a resource, the system compasses his or her ID and privileges contained in the access token with those contained in the access control list. If there is a match, the user is granted access.

(iv) **Discretionary Access Control :** The system administrator usually determines who is granted access to specific resources and maintains the access control list. However, in distributes system, resources may be controlled by the end-use. Resource owners in this setting may be granted discretionary access control, which allows them to grant access privileges to other users. For example, the controller who is owner of the general ledger grants read only privilege to the budgeting department while accounts payable manager is granted both read and write permission to the ledger.

Answer 27. (b)

Subversive threats refer to a situation where an intruder attempts to violate the integrity of some components in the subsystem. By installing an invasive tap on communication line, he can read and modify data or through inductive tap, he can monitor electromagnetic transmissions and allow the data to be read only. Subversive attacks can provide intruders with important information about messages being transmitted.

The intruders can manipulate messages in following ways :

(i) Intruders may insert a message in a message stream being transmitted e.g. EFTs add transfer of funds in an additional account.

(ii) They may delete a message being transmitted, e.g. remove a/c withdrawal message.

(iii) They may modify the contents of message e.g. increase the amount filled in a deposit transaction.

(iv) Intruders may alter the order of the message in a message stream.

(v) They may duplicate message in a message stream, or copy deposit transactions for their accounts.

(vi) They may deny message services between a sender and a receiver by discarding messages or delaying messages.

(vii) They may use techniques to establish spurious associations so that they are regarded as legitimate users of a system. They may play back a handshaking sequence previously used by a legitimate user of the system.

Q. 28. For a material inventory control system, explain the following :

(i) System interfaces

(ii) Files and inputs

(iii) Reports

Answer 28.

The material inventory control system is the point at which materials enter the manufacturing accounting system. This system controls inventory and minimizes the costs of purchasing and holding of inventory. The materials inventory control system interfaces directly with the accounts payable, general ledger, production planning, production scheduling and work-in-process control systems.

(i) **System interfaces :** The objectives of materials inventory control system are to provide accounts payable system with information about vendors and the receipt of goods. Vendor information is first required when sourcing decisions are made. When an order is received, the material inventory control system reports to accounts payable, which in turn, reports to authorize payment.

Materials inventory control provides the general ledger with certain accounting information such as the value of the purchases received, materials transferred into production and the inventory on hand. It generates aggregate journal entries under the following heads: materials inventory, accounts payable, work-in-process and factory overhead control – indirect materials. These entries are sent to general ledger for the accounting transactions.

The work-in-process control system contains the work-in-process accounts.

Direct and indirect materials are requisitioned from the inventory control system and transferred to work-in-process control. On occasion, materials are returned from the production department to materials inventory control.

Information concerning the quantities of items required for scheduled production is provided to materials inventory control systems from the production scheduling system. This information is used in determining order quantities and timing. Similarly, information about materials returned from the production department is recorded in materials inventory control. It also provides information concerning quantities available and expected delivery dates to the production scheduling system. This information is then used for scheduling production.

(ii) **Files and Inputs :** There are two basic input files for the materials inventory control system. The items master file contains one record for each item of the inventory. Some of the data items contained in each record are: inventory item number, item description and specification, current quantity on hand, current quantity on order, current period receipts, year-to-date receipts, current period issues, year-to-date issues, standard cost and vendor identification.

The item master is updated when a purchase order is created or items are placed in the inventory.

The purchase order file contains information about new purchase orders. These result from reduced quantities in the inventory or anticipated production requirements. The following data items are found in each record of the purchase order file; inventory item number, item description and specification, vendor identification, quantity ordered, date of order, delivery date, shipping instructions, order status, purchase cost, purchase order number and item quantity actually received.

(iii) **Reports :** The materials inventory control system generally produces following reports on periodic basis :

- An inventory status report contains the quantity of each item available on a particular date. The report provides the unit cost of an item and any costing technique such as FIFO, LIFO and average

cost etc. can be used. The report also includes the beginning balance, transfers, receipts, adjustments and ending balance of each item.

- An open purchase order report contains information concerning the status of open purchase orders. It includes the item number, vendor identification, date of order, unit cost, quantity ordered, promised shipping date, and other status information.
- Performance measurement reports contain information concerning turnover, stock-outs, shrinkage, investment and other appropriate measurements related to management performance in inventory control.
- The material inventory control system provides the facility of frequently answering the queries. The system is designed to respond instantaneously to these queries so that constant monitoring and control can be exercised on material inventory.

Q. 29. (a) Discuss the review areas of an IS Auditor.

(b) Briefly discuss the framework on which the auditor should work for the audit of Computer Security.

Answer 29. (a)

The IS auditors may focus on following review areas :

(i) **Computerised systems and applications :** The auditor should verify that systems and applications are appropriate to the users' needs, efficient and adequately controlled to ensure valid, reliable, timely and secure input, processing and output at current and projected levels of system activity.

(ii) **Information Processing Facilities :** This facility must be controlled to ensure timely, accurate and efficient processing of applications under normal and potentially disruptive conditions.

(iii) **Systems Development :** An IS auditor should ensure that systems under development meet the objectives of the organization, satisfy user requirements and provide efficient, accurate and cost effective systems and applications. The auditor should also ensure that these systems are written, tested and installed in accordance with generally accepted standards for systems development.

(iv) **Management of Information Systems :** MIS must develop an organizational structure and procedures to ensure a controlled and efficient environment for information processing. This plan should also specify the computers and peripheral equipments required to support all functions in an economic and timely manner.

(v) **Client/Server, Telecommunications and Intranets :** In a client/server environment, all applications that can be dedicated to a user are put on the client. All resources that need to be shared are put on the server. Auditors must ensure that controls are in place on the client as well as on the server and on the network. Auditors must provide the same level of control assurance in an Internet/Intranet environment as in a client/server environment, with special emphasis on TCP/IP and HTTP.

Answer 29. (b)

A framework on which the auditor should work for the audit of computer security is given below :

(i) **Types of Errors and Fraud :**

- Theft of or accidental or intentional damage to hardware and files.
- Loss or theft of or unauthorized access to programs, data files, and other system resources.
- Loss or theft of or unauthorized disclosure of confidential data.
- Unauthorized modification or use of programs and data files.
- Interruption of crucial business activities.

(ii) **Control Procedures :**

- Information security/protection plan.
- Restrictions on physical access to computer equipment.
- Logical access controls based on password protection and other authentication procedures.
- Data storage and transmission controls such as encryption.
- Virus protection procedures.
- File backup and recovery procedures.
- Fault-tolerant systems design.
- Disaster recovery plan.
- Preventive maintenance.
- Firewalls.
- Information systems insurance.

(iii) **Audit Procedures :** System Review

- Inspect computer sites.
- Interview IS personnel about security procedures.
- Review written documentation about physical access policies and procedures.
- Review logical access policies and procedures.
- Review file backup and recovery policies and procedures.
- Examine data storage and transmission policies and procedures.
- Review procedures employed to minimize system downtime.
- Examine system access logs.
- Examine disaster recovery plan.
- Examine casualty insurance policies.

(iv) **Audit Procedures :** Tests of Controls

- Observe computer site access procedures.
- Observe the preparation and off-site storage of backup files.
- Review records of password assignment and modification.
- Investigate how unauthorized access attempts were dealt with.
- Verify the extent of data encryption use.
- Verify the effective use of data transmission controls.
- Verify the effective use of firewalls.
- Verify the effective use of virus protection procedures.
- Verify the use of preventive maintenance and uninterruptible power.
- Verify amounts and limitations on insurance coverage.
- Examine the results of test simulations of disaster recovery plan.

(v) **Compensating Controls :**

- Sound personnel policies.
- Effective user controls.
- Segregation of incompatible duties.

Q. 30. (a) What is a Digital Signature? How is it used?

(b) Write short notes on the following :

(i) Computer Crimes and Penalty in IT Act 2000

(ii) Computer Network u/s 2 of IT Act ,2000

(c) What are the powers of the Central Government to make rules, as given in Section 87, Chapter XIII of Information Technology Act, 2000?

Answer 30. (a)

Digital signature means authentication of any electronic record by a subscriber by means of an electronic method or procedure.

The digital signature is created in two distinct steps. First the electronic record is converted into a message digest by using a mathematical function known as "hash function" which digitally freezes the electronic record thus ensuring the integrity of the content of the intended communication contained in the electronic record. Any tampering of the contents of the electronic record will immediately invalidate the digital signature. Secondly, the identification of the person affixing the digital signature is authenticated through the use of the private key which attaches itself to the message digest and which can be verified by anybody who has the public key corresponding to such private key. This will enable anybody to verify whether the electronic record is retained intact or has been tampered with since it was so fixed with the digital signature. It will also enable a person who has a public key to identify the originator of the message.

Section 5 of Chapter III provides for legal recognition of Digital Signatures where any law requires that any information or document should be authenticated by affixing the signature of any person, then such a requirement can be satisfied if it is authenticated by means of Digital Signatures affixed in such manner as may be prescribed by the Central Government.

Answer 30. (b)

(i) In IT Act, 2000, the Chapter XI deals with some computer crimes and provides penalties amounting one to two years imprisonment with or without a fine of 1-2 lakh or both. The Section 65 to 78 deals with these crimes and provides for penalties for these offences. Some of the important crimes are as following :

(I) Section 65 provides for punishment for tampering with computer source documents

(II) Section 66 provides for punishment for hacking with computer system

(III) Section 67 provides for punishment for publishing or transmitting or causing to be published or transmitted, information which is obscene in electronic form.

Section 71 to 78 of IT Act provides for penalties. Some of the important penalties are as following :

(I) Misrepresenting or suppressing any material [Section 71] – imprisonment for upto two years or fine which may extend to Rs. 1 lakh or both.

(II) Breach of confidentiality and privacy of electronic records, books, information [Section 72] - imprisonment upto two years or fine of ₹ 1 lakh or both.

(III) Publishing false Digital Signature Certificate [Section 73] - imprisonment for a term of upto two years or fine of ₹ 1 lakh or both.

(IV) Publishing of Digital Signature Certificate for fraudulent purpose [Section 74] - imprisonment for a term of upto two years or fine of ₹ 1 lakh or both.

(V) Offence committed outside India involving a computer, computer system or computer network located in India [Section 75].

(ii) Computer Network u/s 2 of IT Act, 2000 :

It refers to the interconnection of two or more computers through the use of special cabling like UTP/Fiber optic cable, telephone lines, microwave or satellite link or other communication media; and terminals or a complex consisting of two or more interconnected computers whether or not the interconnection is continuously maintained.

Answer 30. (c)

Section 87 of the Information Technology Act, 2000 confers on the Central Government the power to make rules by notifying in the Official Gazette and the Electronic Gazette, in respect of certain matters, some of which are :

- Manner in which
  - any information or matter may be authenticated by means of digital signature under section 5;
  - electronic records shall be filed, created or issued and the method of payment;
  - digital signature may be affixed under section 10;
  - the adjudicating officer shall hold enquiry under section 46.
- (Electronic) Form in which
  - electronic records shall be filed, created or issued;
  - Digital signature may be affixed under section 10;
  - an application for licence may be made;
  - application is made for renewal of licence under section 23;
  - application for issue of a digital signature certificate may be made;
  - appeal may be filed .
- Prescribing fee
  - payable along with application for license;
  - for renewal of a licence under section 23;
  - (late) payable under proviso to section 23;
  - to be paid to certifying authority for issue of digital signature certificate;
  - for filing an appeal.
- Prescribing salary, allowances and other conditions of service of the
  - Presiding Officer under section 52;
  - officers and employees.
- Prescribing procedure
  - for security, for the purpose of creating secure electronic record and secure digital signature under section 16;
  - for investigation of misbehaviour or incapacity of the Presiding Officer .

- Prescribing
  - standards to be observed by the Controller ;
  - requirements which an applicant must fulfil ;
  - period of validity of licence granted ;
  - documents which shall accompany an application for licence;
  - qualification and experience which the adjudicating officer shall possess;
  - any other power of the civil court;

- Matters relating to the
  - type of digital signature under section 10;
  - any other.

Every notification made by the Central Government shall be laid, as soon as possible after it is made, before each House of Parliament, while it is in session, for a total period of thirty days. This period may be comprised in one session or in two or more successive sessions. If before the expiry of the session immediately following the above period, both Houses agree in making any modification, the rule will thereafter have effect only in the modified form. Similarly, if both Houses agree that the rule should not be made, the notification shall have no effect, thereafter.