Paper 9 - Operations Management & Information Systems

Time allowed-3hrs   Full Marks: 100

Section I
(Operations Management)
Answer Question No. 1 which is compulsory and answer any two from the rest, under Section I.

Working Notes should form part of the answer.

1. (a) Match the terms in Column I with the relevant terms in Column II: [0.5 x 8=4]

Column I	Column II
(A) Fork-lift-Truck	(i) Milling Machine
(B) Teeth on a gear wheel	(ii) Move heavy loads over rectangular area
(C) Electrical Overhead Travelling	(iii) Go-No Go gauge
(D) Methods Time measurement	(iv) Drilling Machine
(E) Industrial Finance Corporation of India	(v) Handling crates on pallets within a factory
(F) ABC	(vi) Project funding
(G) Hole in a block	(vii) Work measurement
(H) Inspection	(viii) Classification based on annual usage value

(b) Expand the following abbreviations: [1 x 5 =5]

   (i)   FMS
   (ii) CRAFT
   (iii) IPPS
   (iv) LOB
   (v)   BOLT

(c) State whether following statements are true or false: [1 x 5 =5]

   (i) 'Routing' and 'Scheduling' are not interconnected and both can be carried out separately and independently.
   (ii) Process improvement is not necessary when the process is slow in responding to the customer.
   (iii) Dummy Activities are used in Network Analysis.
   (iv) Vertical lines of authority and responsibility must be kept as short as possible.
   (v) Annealing involves heating and cooling operations.

Answer:

1. (a) (A) - (v); (B) - (i); (C) - (ii); (D) - (vii); (E) - (vi); (F) - (viii); (G)-(iv);(H)-(iii).

   (b) (i)   Flexible Manufacturing System.
        (ii)   Computerized Relative Allocation of Facilities Techniques.

    (iii)   Integrated Production Planning System.
    (iv)   Line Of Balance.
    (v)   Built, Operate, Lease and Transfer.

(c) (i) False. 'Routing' and 'Scheduling' are interconnected and are independent and either of these activities cannot be undertaken independently.
    (ii) False. Process improvement is necessary when the process is slow in responding to the customer.
    (iii) True
    (iv) True
    (v) True

2. (i) A plant manager is considering replacement policy for a new machine. He estimates the following costs.   **(All costs in ₹ 000)**

Year	1	2	3	4	5	6
Replacement cost at beginning of year	100	110	125	140	160	190
Salvage value at end of year	60	50	40	25	10	0
Operating costs	25	30	40	50	65	80

Find an optimal replacement policy and corresponding minimum cost.   **[6]**

(ii) Define Degeneracy in a simplex LPP. How is it resolved?   **[5]**

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

[7]

3. (i) The following costs have been recorded:

Particulars	₹
Incoming materials inspection	10,000
Training of personnel	30,000
Warranty	45,000
Process planning	15,000
Scrap	9,000
Quality laboratory	30,000
Rework	25,000
Allowances	10,000
Complaints	14,000

What are the costs of prevention, appraisal, external failure and internal failure?   **[6]**

(ii) The ARB Company is planning to design, develop and market a new racing cycle. The project is composed of the following activities:

Activity	Description	Predecessors	Time (weeks)
A	Design frame	-	4
B	Design wheels	-	3
C	Design gears	-	3
D	Design handle bars	C	2
E	Test steering	A,B,D	1
F	Test gears	A,B,D	2
G	Performance test	E,F	3
H	Manufacturing layout	A,B,D	3
I	Manufacturing demonstration	H	5
J	Preparing advertising	G	2
K	Preparing users manual	G	4
L	Distribute to dealers	I,J,K	2

Draw the network; find critical path and total duration of project.

[9]

(iii) Define "Plant Shut Down"? Under what situations will you advise to resort to plant shut down? [3]

4. (i)   After observing heavy congestion of customers over a period of time in a petrol station, Mr. Ustad has decided to set up a petrol pump facility on his own in his near by site. He has complied statistics relating to the potential customer arrival pattern and service pattern as given below. He has also decided to evaluate the operations by using the simulation technique.

Arrivals		Services	
Inter-arrival time (minutes)	Probability	Inter-arrival time (minutes)	Probability
2	0.22	4	0.28
4	0.30	6	0.40
6	0.24	8	0.22
8	0.14	10	0.10
10	0.10		

Assume:
(i) The clock starts at 8.00 hours
(ii) Only one pump is set-up
(iii) The following 12 Random Nos. are to be used to depict the customer arrival pattern

78	26	94	08	46	63	18	35	59	12	97	82

(iv) The following 12 Random Nos. are to be used to depict the service pattern

44	21	73	96	63	35	57	31	84	24	05	37

You are required to find out the
- Probability of the pump being idle
- Average time spent by a customer waiting in queue. [12]
(ii) Write a note on Concept Testing. [6]

Answer:

2. (i)

Year(n)	Operating Cost M(t)	Cumulative operating cost ∑M(t)	Replacement cost at beginning of year (C)	Salvage value at end of year S(t)	Depreciation C-S(t)	Total Cost TC_n	Average Cost ATC_n
(1)	(2)	(3)	(4)	(5)	(6)=(4-5)	(7)=(3+6)	(8)=(7/1)
1	25	25	100	60	40	65	65
2	30	55	110	50	60	115	57.5
3	40	95	125	40	85	180	60
4	50	145	140	25	115	260	65
5	65	210	160	10	150	360	72
6	80	290	190	0	190	480	76.7

Since the average total cost per year is minimum in the second year, the machine should be replaced after 2 years and the corresponding minimum annual cost of replacement is ₹57500.

(ii) The concept of obtaining a degenerate basic feasible solution in a LPP is known as Degeneracy. The degeneracy in a LPP may arise
- At the initial stage when at least one basic variable is zero in the initial basic feasible solution.
- At any subsequent iteration when more than one basic variable is eligible to leave the basic and hence one or more variables becoming zero in the next iteration and the problem is said to degenerate. There is no assurance that the value of the objective function will improve, since the new solutions may remain degenerate. As a result, it is possible to repeat the same sequence of simplex iterations endlessly without improving the solutions. This concept is known as cycling or circling.
  Degeneracy is solved by the following procedure:
  (i) Divide each element in the tied rows by the positive coefficients of the key column in that row.
  (ii) Compare the resulting ratios, column by column, first in the identity and then in the body, from left to right.
  (iii) The row which first contains the smallest algebraic ratio contains the leaving variable.

(iii)

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

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

Let X_1, X_2, X_3 & X_4 be the units produced of A,B,C & D respectively.
Objective Function-
$Z_{MAX} = 5X_1 + 7X_2 + 3X_3 + 9X_4$
Subject to –
Material 1: $4X_1 + 3X_2 + 8X_3 + 2X_4 \leq 800$
Material 2: $1X_1 + 2X_2 + 0X_3 + 1X_4 \leq 300$
Machine Hour: $8X_1 + 5X_2 + 0X_3 + 4X_4 \leq 500$
Labour Hours: $3X_1 + 2X_2 + 1X_3 + 5X_4 \leq 900$

3. **(i)**

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

(ii)
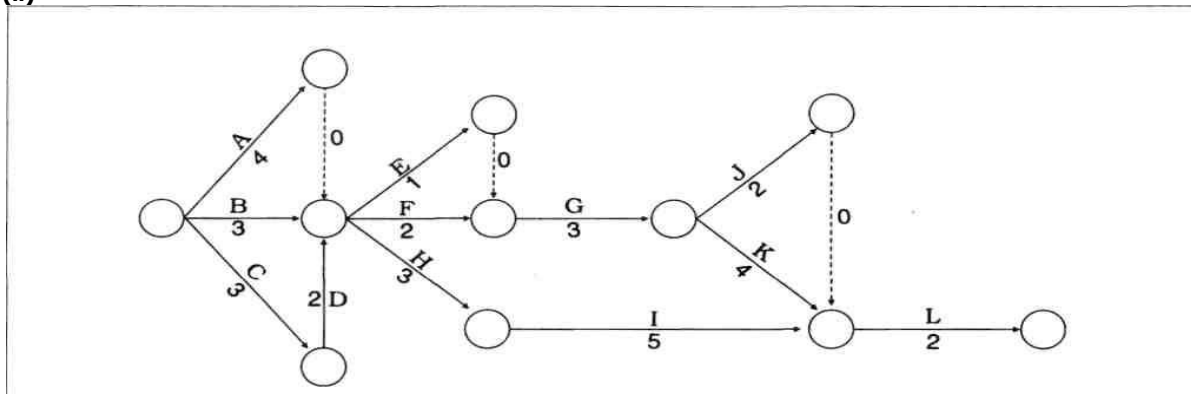
Paths	Duration	Paths	Duration
AEGJL	4+1+3+2+2=12	CDFGKL	3+2+2+3+4+2=16
AEGKL	4+1+3+4+2=14		Critical path
BEGJL	3+1+3+2+2=11	CDFGJL	3+2+2+3+2+2=14
BEGKL	3+1+3+4+2=13	CDEGJL	3+2+1+3+2+2=13
BFGJL	3+2+3+2+2=12	CDHIL	3+2+3+5+2=15
BFGKL	3+2+3+4+2=14	CDEGKL	3+2+1+3+4+2=15

(iii) 'Plant shutdown' means total stoppage of plant and production activities by cutting off in-coming power supply to the plant. Plant shutdown is resorted to under the following conditions :

(i) At the time of puja holidays for doing preventive and major overhauling jobs.
(ii) Due to unusual situations.
(iii) At the time of recession when demands fall considerably.
(iv) When prices are less than total cost.
(v) For minor repair of generators, transformers, etc., after the normal working hours.

4. (i)

Inter-arrival time				Service time			
Inter-arrival time (minutes)	Probability	Cumulative probability	Range	Inter-arrival time (minutes)	Probability	Cumulative probability	Range
2	0.22	0.22	00-21	4	0.28	0.28	00-27
4	0.30	0.52	22-51	6	0.40	0.68	28-67
6	0.24	0.76	52-75	8	0.22	0.90	68-89
8	0.14	0.90	76-89	10	0.10	1.00	90-99
10	0.10	1.00	90-99				

Sl.no	Random No. for inter-arrival	Inter-arrival time	Entry time in queue	Service start time	Random no. for service	Service time	Service end time	Waiting time of customer	Idle time
1	78	8	8.08	8.08	44	6	8.14	-	8
2	26	4	8.12	8.14	21	4	8.18	2	-
3	94	10	8.22	8.22	73	8	8.30	-	4
4	08	2	8.24	8.30	96	10	8.40	6	
5	46	4	8.28	8.40	63	6	8.46	12	
6	63	6	8.34	8.46	35	6	8.52	12	
7	18	2	8.36	8.52	57	6	8.58	16	
8	35	4	8.40	8.58	31	6	9.04	18	
9	59	6	8.46	9.04	84	8	9.12	18	
10	12	2	8.48	9.12	24	4	9.16	24	
11	97	10	8.58	9.16	05	4	9.20	18	
12	82	8	9.06	9.20	37	6	9.26	14	
Total Validity Time								140	12

Average waiting time spent by the customer= 140/12= 11.67 minutes.
Probability of idle time of the petrol station= 12/86= 0.1395 or 13.95% idle, say 14%.

(ii) This is concerned with measuring customer reactions to the idea or concept of a product. In fact, it is a kind of research in which the product idea is screened before any money, time or labour are committed to making the prototype products. The idea of a product with as many details as possible is made known to the customers either verbally or through the use of suitable blueprints. The response of the customers is checked and only if it is found encouraging then the development of product prototype is taken up. For instance, when the_ rest of the world had largely gone in for synthetic detergent in the powder form, it was

decided by the Hindustan Lever Limited to test a *detergent bar* as a concept, because in India most people do not use washing machines or even buckets and are accustomed to using a bar to rub on the fabric.

The concept testing can tell whether the product is likely to be a future success or not. To achieve better results, however, the product concept should include the finished product itself, with all details, *viz.*, packaging, price category, the brand name, etc. On the basis of these details interviews are conducted to collect the opinion of the would be purchasers.

The major advantage of concept testing is that the management could form early judgments on the likelihood of the market success of the new ideas. The other objectives of concept testing could be:

To evaluate the relative merits of several new product proposals,

To determine whether the product idea is to be abandoned or modified,

To determine the size of the potential market,

To guide the management to adopt suitable marketing policies in advance.

Concept testing has the following limitations or drawbacks:

It entails some risk of disclosing the company plans to competitors.

There is a time-lag for obtaining and assessing the results.

Respondents may overstate their interest and encourage unsound development.

The validity of any measure of potential market size obtained through early stage concept testing is often dubious.

Findings may be misleading if the test is not carried out properly.

Section II
Information System
Answer Question No. 5 which is compulsory and answer any two from the rest, under Section II.

5. **(a) Fill in the blanks given below :**   **[1 x 5 =5]**
    (i) Eliminating errors of a program is called--------------.
    (ii) -------------- generally refers to an intelligent terminal in a networking environment.
    (iii) The range of frequencies available for data transmission is called-------.
    (iv) An extra bit in a byte that enables the computer to check for internal errors is called ------- bit.
    (v) The activities of an Information System is collection, generation and --------of information to right users.

    (b) Expand the following abbreviations: **[1 x 5 =5]**
    (i) RADIUS
    (ii) INGRES
    (i) SQL
    (ii) EIS
    (iii) WAIS

    (c) State whether following statements are true or false: **[1x 4 =4]**
    (i) Real time processing has fixed time constraints.
    (ii) In LAN each computer can fulfill a function.
    (iii) The higher the management, more structured are the problems.
    (i) Virtual memory is provision of secondary storage which acts as secondary memory.

Answer:

5. **(a)** (i) Debugging
(ii) Workstation
(iii) Bandwidth
(iv) Parity
(v) Dissemination

(b) (i) Remote Authentication Dial In User Service
(ii) Interactive Graphics Relational System
(iii) Structured Query Language
(iv) Executive Information System
(v) Wide Area Information Service

(c) (i) True
(ii) True
(iii) False
(iv) False

6. **(i) Define Fourth Generation Languages.**   **[3]**
(ii) Distinguish between Business Process Outsourcing and Business Process Reengineering. [6]
(iii) Discuss the role of System Analyst.   **[5]**
(iv) List the advantages of Prototyping Model.   **[4]**

7. **(i)   List the automated office components along with their major functions.**   **[6]**
(ii)   Describe the term 'Going live' in relation to ERP implementation.   **[4]**
(iii) List the eight basic features of Management Information System (MIS).   **[8]**

8. **(i) Discuss the components of Electronic Data Interchange (EDI).**   **[6]**
(ii) Describe Digital Signature Certificate.   **[6]**
(iii) Define World Wide Web? How would you distinguish it from Internet?   **[6]**

Answer:

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

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

Business Process Reengineering (BPR) refers to the analysis and redesign of workflows and processes both within and between organizations. The orientation of the

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

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

(iv) Advantages of Prototyping Model are:
- It provides quick implementation of an incomplete, but functional, application.
- Prototyping requires intensive involvement by the system users.
- A very short time period is normally required to develop and start experimenting with prototype.
- Since system users experiment with each version of the prototype through an interactive process, errors are hopefully detected and eliminated early in the developmental process.
- It reduces the cost of user training.
- It improves the fact finding process.
- It helps to identify confusing or difficult functions and missing functionality.
- Prototyping model encourages innovation and flexible designs.

7. (i) Automated office is a multifunction integrated computer based system that allows many office activities to be performed in an electronic mode. It is a new way of preparing documents and enhanced communication method. It places the power of computing in hands of office executives. It helps in filing, storing and retrieving documents.
Components of the automated office and major functions thereof are:
(i) **Word processing**- It provides preparation of typed document in different ways, their storage, revision and printing.
(ii) **Electronic Mail-** It allows typed message to be sent to or received from any part of the world electronically.
(iii) **Voice Mail**- It facilitates spoken message to be sent to or received from any part of the world electronically.
(iv) **Facsimile-** It allows any typed or handwritten or printed documents to be sent to or received from any part of the world electronically.
(v) **Tele-conferencing**- It facilitates conferencing or meeting among persons located at different places.
(vi) **Personal computing**- It places computing decision support at workers' fingertips.

(vii) **Reprographics**– A combination of automated machines for providing multiplicities of documents like photocopies, scanners, laser printers etc.

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

Post-implementation maintenance**:** Once the implementation is over, the services of vendor and the hired consultants will not be available. Trained in-house employees may have limited exposure to take care of all the problems just after implementation. Post implementation needs a different set of roles and skills to solve the problems in an integrated system. The training will never end. New functionality may be added which will invite different technical problems like enhancement of system, fresh configuration for added integration features. Thus, this is a very critical phase. To reap the full benefit of ERP system, there should be arrangement for continuous training of employees and periodical review on how to enhance the advantage from the system.

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

8. **(i)** EDI consists of three components:

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

   • Mapping - To build a map, the user first selects the EDI standard for the kind of data he wants to transmit. Usually the trading partner tells about the kind of standards to

be used. Next, he edits out parts of the standards, which do not apply, to his application. Next, he imports a file that defines the fields in his application, and finally he makes the map to show where the data required by the EDI standards is located in his application. Once the map is built, the translator will refer to it during EDI processing every time a transaction of that type is sent or received.

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

(ii) A digital signature certificate is a mechanism for authenticating and securing the information that is transmitted between the two parties. It is an authoritative identification about a person or a company. It is simply a public key along with some identifying information., that has been digitally signed by a certificate authority. It identifies the subscriber, certification authority, and its operational period and contains the subscriber public key. The certificate is thus protected so that it cannot be altered without detection. It is like an electronic passport that authenticates identity of an entity. The identifying information in the certificate can be trusted because the digital signature is cryptically strong.

Legal recognition of digital signature, electronic records and authentication is necessary in an electronically formed contract. The Information Technology Act provides legal status on the use of the electronic records and signatures. Authentication and non-repudiation are secured through the mechanism of digital signature. The digital signature certificate ensures that the purported sender is in fact the person who sent the message.By certifying that a particular public key does indeed belong to a specific person, it authenticates and makes digital signature conclusive. For verification of such signature, the verifier must have the signer's public key and have an assurance that it corresponds to his private key. Digital certificate associates a particular person to that pair. Its basic purpose is to serve the need of the person seeking to verify a digital signature who would want to know that:

- The public key corresponds to the private key used to create the digital signature
- Whether the public key is identified with the signer.

Section 35 of the Act deals with the issue of the digital certificate by the Certifying Authority, on an application being made in the prescribed form.

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

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