PAPER – 9 – OPERATIONS MANAGEMENT & INFORMATION SYSTEMS

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Full Marks: 100 **Time Allowed: 3 hours**

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

Section A

I. Answer the following question which is compulsory:

1. Answer all the questions: **[2 × 10 = 20]**

a) The time needed to produce goods or provide services. This can involve scheduling repairing equipment, methods used, inventories, quality, training and the like.

b) Human factor engineering or ergonomics applies knowledge of human capabilities and limitations to the design of product and process poorly designed products may cause work related accidents resulting in injuries to users. Hence, comfort, safety and ease of use for the users are becoming more important quality dimensions that have to be considered in product design.

c) Capacity planning is the process of determining the production capacity needed by an organization to meet changing demands for its products. In this context, capacity is the maximum amount of work that an organization is capable of completing in a given period.

d) Linear programming is an optimization technique that allows the user to find a maximum profit/revenue or a minimum cost, based on the availability of limited resources and certain constraints.

e) The term productivity can be defined in two ways. In simple terms, productivity is defined as a ratio between the output and input.

$$\text{Productivity} = \frac{\text{Output obtained}}{\text{InputsConsumed}}$$

In a broader sense, productivity is defined as a measure of how well resources are brought together in organizations and utilized for accomplishing a set of results. Productivity is achieving the highest results possible while consuming the least amount of resources.

$$\text{Productivity} = \frac{\text{Performance achieved}}{\text{Resources consumed}} = \frac{\text{Effectiveness}}{\text{efficiency}}$$

f) Italian Sociologist Pareto's principle is found useful in 'QC' at every level, Pareto proved after studying the economic condition of Italy that 80% of the country's wealth is divided between 20% of the people. This is also known as 80 – 20 principle. According to this principle if 80% of accidents are according in 20% of factory then 20% factories are having unsafe working procedures. According to Pareto, the important cause are always quite less in number 'QC' focuses its attention on these less but important problems.

g) Entropy is the quantitative measure of disorder in a system entropy requires inputs of Energy to repair replenish and maintain the system. This maintenance input is termed as negative Entropy open systems require more negative entropy than relatively closed systems for keeping at a steady state.

System	Maintenance of Entropy	Negative Entropy
Automobile	Engine won't start, tyres too thin	Tune up engine, replace tires.
Computer program	User dissatisfaction with features and errors.	Program enhancements.

h) Primary key is a key which is used to find the record uniquely. It should be "NOT NULL" and unique
Ex: - Registered no of a student, employee numbers, bank Account numbers etc.

i) Key pair in a asymmetries crypto system, means a private key and its mathematically related public key, which are so related that the public key can digital signature created by the private key.

j) Iconic scale Model: It is physical replica of the system based on different scale from original. Iconic models may appear to scale in three dimensions – such as model of production process, building, car or an aircraft.

2. Match List A with List B **[5 × 1 = 5]**

List A	List B
a) ISO	1) Standardization
b) WIP	2) Production control
c) CNC	3) Machine Tool
d) Java	4) A programming language
e) Router	5) A networking peripheral

Section B **[15 × 3 = 45]**

1. (a) (i)

	Activity	A	B
Fixed cost	Interest on capital @ 15% p. a.	7,500	12,000
Variable cost	Operating cost P. a.	20,000	16,000
Total cost	Total Annual cost	27,500	28,000
output	Total output	10,000	16,000
	Cost per unit	2.75 ₹	1.75 ₹

∵ Machine "B" gives lower unit cost per unit if run whole year.

(ii) If only 4,000 units are to be produced in an year activity

Activity	A	B
Fixed Interest on capital	7,500	12,000
No. hrs required	800	500
V. C. operating charges	8,000	4,000
Total cost	15,500	16,000
Cost per unit	3.875 ₹	4 ₹

∵ For 4,000 units 'A' gives lowers cost.

(iii) If 12.5% of output of Machine 'B' is rejected at the inspection stage.

$$B = 16{,}000 \times \left[\frac{100 - 12.5}{100}\right]$$

$$= 16{,}000 \times \left[\frac{87.5}{100}\right]$$

= 14,000 useful units.

$$\therefore \text{ cost per unit} = \left[\frac{28{,}000}{14{,}000}\right] = 2\ ₹$$

Even with 12.5% of rejection also "B" is suitable.

(b)

Year	x Time deviation	Y Sales	x^2	Xy' 000 Units
2001	-3	80	9	-240
2002	-2	90	4	-180
2003	-1	92	1	-92
2004	0	83	0	0
2005	1	94	1	94
2006	2	99	4	198
2007	3	92	9	276
	$\sum x = 0$	$\sum y = 630$	$\sum x^2 = 28$	$\sum x = 56$

n = 7

Regression Equation of y on x.

$y = a + b \times x$

$a = \frac{\sum y}{x} = \frac{630}{7} = 90$

$b = \frac{\sum xy}{\sum x^2} = \frac{56}{28} = 2$

∴ Projects sales for next 3 years.

Year 2008	= 90 + 2 × 4,000	= 98000
Year 2009	= 90 + 2 × 5,000	= 100000
Year 2010	= 90 + 2 × 6,000	= 102000

2. (a)

	T_0	C_1	C_2	C_3	
From	M_1	8	7	6	250
	M_2	5	4	9	320
	M_3	7	5	5	280
		300	260	180	740/850

It is unbalanced, Balance it by introducing "Dummy Column"

	C_1	C_2	C_3	C_4		Penalty
M_1	8	7	6 140	0 110	250 / 140	6* / 1 / 1 / 1
M_2	5 300	4 20	9	0	320 / 20 / 0	4 / 1 / 5 * 1
M_3	7	240 5	40 5	0	280 / 40 / 0	5 / 0 / 0 / 0
	~~300~~ 0	260 240 0	180	110	850	

Penalty

2	1	1	0
2*	1	1	–
–	1*	1	–

No. of allocation = 6 = (m + n – 1)

So go for optimality test

	C_1	C_2	C_3	C_4	Mi
M_1	8 / 1	7 / 1	6 / 140	0 / 110	0
M_2	5 / 300	4 / 20	9 / 5	0 / 2	-2
M_3	7 / 1	5 / 240	5 / 40	0 / 1	-1
V_j	7	6	6	0	

all $\Delta ij \geq 0$ solution is optimal.

M_1	–	C_3	-	140 × 6	= 840
		C_4	-	110 × 0	= 0
M_2	–	C_1	-	30 × 5	= 1500
		C_2	-	20 × 4	= 80
M	–	C_2	-	240 × 5	= 1200
		C_3	-	40 × 5	= 200
					3820

∴ Optimal transportation Cost = 3820.

(b)

Year	Net Capital = Cost – Resale Value	Running Cost	Cum. Running Cost	Total Cost	Average Cost
1	(6500 – 4000) = 2500	1400	1400	3900	3900
2	(6500 – 3000) = 3500	1500	2900	6400	3200
3	(6500 – 2200) = 4300	1700	4600	8900	2967
4	(6500 – 1700) = 4800	2000	6600	11400	2850
5	(6500 – 1300) = 5200	2400	9000	14200	2840*
6	(6500 – 1000) = 5500	2800	11800	17300	2883
7	(6500 – 1000) = 5500	3300	15100	20600	2943
8	(6500 – 1000) = 5500	3900	19000	24500	3063

Hence, optimal replacement period is at end of 5th year.

3. (a) (i) Given Fixed Cost = 6,000
Variable Cost = ₹ 2
Selling Price = ₹ 7

Break Even Volume $= \frac{\text{Fixed Cost}}{\text{Selling Price - Variable Cost}} = \frac{6,000}{7-2} = \frac{6,000}{5} = 1200$ units

(ii) If 1000 units produced

Profit = Total Selling Price – Total Cost
= (1000 × 7) – 6,000 + (1000 × 2)
= 7000 – (6000 + 2000)
= (1000) loss

If 1000 units to be produced, 1000 loss can be occurred.

(iii) To get ₹ 4,000 profit per month.

Profit = Revenue – Total Cost
4,000 = (x × 7) – (6,000 + (x × 2)
4,000 = 7x – 6,000 + 2x
4000 + 6000 = 5x
$X = \frac{10,000}{5}$ = 2,000 units.

(b) The principle of production planning and control lies in the statement "first plan your work and then work on your plan. Main functions of production planning and control include Planning, Routing Scheduling, Dispatching and Follow-up.

- Planning is deciding in advance what to do, how to do it, when to do it and who is to do it. Planning bridges the gap from where we are, to where we want to go. It makes it possible for things to occur which would not otherwise happen.
- Routing may be defined as the selection of path, which each part of the production will follow, which being transformed from raw material to finished products. Routing determines the most advantages path to be followed for department to department and machine to machine till raw material gets its final shape.
- Scheduling determines the programme for the operations scheduling may be defined as the fixation of time and date for each operation as well as it determined the sequence of operators to be followed.
- Dispatching is concerned with the starting the process. It gives necessary authority so as to start a particular work, which has been already been planned under 'Routing' and 'Scheduling'. Therefore, dispatching is release of orders and instruction for the starting of production for any item in acceptance with the route sheet and schedule chart.
- Follow-up is to report daily the progress of work in each shop in a prescribe proforma and to investigate the causes of deviations from the planned performance.

4. (a) Compare the characteristics of three process strategies?
Process Focus (Low Volume – High Variety)

1. Small quantity and large variety of products are produced.
2. General purpose machines and equipments are used.
3. Broadly skilled operators
4. Many job instructions because of job charges.
5. High raw material inventory.
6. High work-in-progress compared to output.
7. Work flow is slow
8. Finished goods or usually made to order and not stored.
9. Production scheduling is complicated, concerned with trade-off between inventory availability, capacity and customer service.
10. Low fixed costs and high variable costs.

Repetitive Focus (Modular):

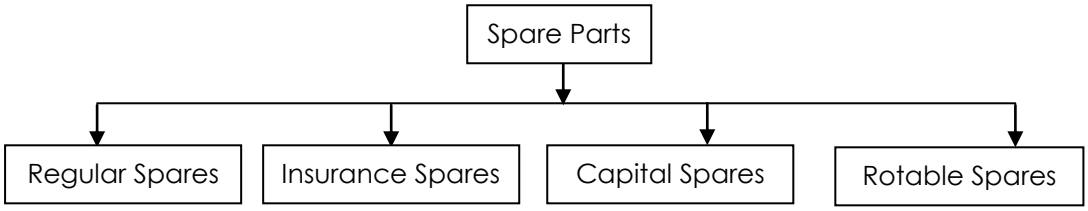
1. Long runs, usually standardized products with options for customers are produced from modules
2. Special equipments used in assembly lines.
3. Modestly trained operators.
4. Repetitive operations reduce job instructions and training.
5. Just-in-time procurement technique are used.
6. Just-in-time production technique are used.
7. Work flow is slow
8. Finished goods are made to frequent forecasts

9. Production scheduling is based on building various models from a variety of modules to forecasts.
10. Fixed costs are dependent on flexibility of the facility.

Product Focus (High Volume – Low Variety)

1. Large quantity and small variety of products are produced
2. Special purpose machines and equipments are used
3. Broadly skilled operators.
4. Few job instructions because jobs are standardized.
5. Low raw material inventories relative to value of output.
6. Work-in-progress inventory is low compared to output.
7. Fast work flow
8. Finished goods are usually mode of a forecast and stored.
9. Simple production scheduling, concerned with establishing a rate of output sufficient to meet demand forecast.
10. Fixed costs tend to be high and variable costs low.

4. (b) Explain the classification of spares:



Regular Spares: (Also called as Maintenance Spares and Breakdown Spares)

These are required regularly and so, in substantial numbers. Both the reliability and the per unit cost of these items are not very high. The service level as mentioned in the earlier chapter on inventories, is given: Service level.

Where Ku = Opportunity Cost of under stock of one unit and
Ko = Opportunity Cost of over stock of one unit.

The Breakdown rates occur either according to a normal distribution (wear – out of the parts) or according to a poisson distribution (system overloads). The mean and variance characteristics of it are known through the past experience.

This, having decided/ computed the service level, it is easy to compute the regular stock required (based on the mean) and the buffer stock required based on the service level and variance (or standard deviation)

Insurance Spares:
Spares of this class have a very high reliability and are required rarely, if ever, during the life time of an equipment besides being a high cost item. Thus, a company or organization which decides to buy such a spare close so only to keep it for the life time of the equipment. Also if the down-time costs of these spares were low if would be easy to decide in favour of processing them when, if at all, required.

But our insurance spare is also a critical item whose non-availability has a very heavy down-time cost, and hence the question should the spare be purchased along with the equipment required or not?

The answer is : if (Probability of failure) × (Downtime Cost) ≥ Purchase Price of a spare the decision should be to buy and keep the spare and vice versa.

Capital Spares:
Regular Spares and Insurance spares are two ends of the spectrum, capital spares fall somewhere in between a few-say five or ten-of these spares are required, over the lifetime of an equipment.

$$\sum_{i=0}^{N-1} P_1 \leq \frac{C_3 - C}{C_3 - S} \leq \sum_{i=0}^{N} P_1$$

Rotable Spares:
These are repairable and re-usable spare, such as a jet engine or an electric motor which can be reconditioned after failure and put back in operation. This situation can be visualized in a multiple channel Single Service Queuing theory format, where the defective equipments are the arrivals and the spares are the servers. The service times are given by the distribution of time to recondition a spare. The inter-arrival times of the defective items can also be modeled in terms of a probability distribution.

Section C

1. (a) **Flow Charts**:

Flow charting is a graphic technique that can be used by analysts to represent the inputs, outputs and process of a business in a pictorial form.

Benefits of Flow Chart:

Communication:
Flow charts are better way of communicating the logic of a system and easily understandable.

Effective analysis:
With the help of flow chart, problem can be analyzed in more effective way.

Proper documentation:
Program flowchart serve as a good program documentation.

Efficient coding:
The flow charts act as a guide during the systems analysis and program development phase

Proper Debugging:
The flow chart helps in debugging process.

Efficient program Maintenance:
The Maintenance of operating program becomes easy with the help of flowchart. It helps the programmer to put efforts more efficiently on that part.

Limitations of using flowcharts:

Complex logic:
Sometimes, the program logic is quite complicated. In that case, flowchart becomes complex.

Alterations and Modifications:
If alterations are required, the flowchart may require redrawing completely.

Reproduction:

As the flowchart symbols cannot be typed, reproduction of flow-chart becomes a problem.

(b) Four types of implementation strategies are follows:

1. **Direct / Abrupt change – over:**
   Conversion by direct change over means that on a specified date the old system is dropped and the new system is put into use. The users have no possibility of using the old system other than the new one. Adoption is a necessity. The disadvantage is that as the old system is dropped and new system is put to use, there is no adequate way to compare new result with old ones.

2. **Phased Change:**
   If each phase is successful then the next phase is started, eventually leading to the final phase when the new system fully replaced the old one. The advantage is that. It allows users to get involved with the system gradually. The disadvantage is that it takes too long to get the new system in place.

3. **Pilot Changer Over**:
   With this strategy, the new system replaces the old one in one operation but only on a small scale, it might be tried out in one branch of the company or in one location. When one operation is successfully completed, other conversions are done for other operations. Each module is thoroughly tested before being used. Users become familiar with each module as it becomes operational.

4. **Parallel running changeover**:
   The old system remains fully operational while the new system come online, the old and the new system are both used alongside each other. If all goes well, the old system is stopped and new system carries on. The advantages is that there is a possibility of checking new data against old data in order to catch any errors in the processing of the new system. The disadvantage is that cost of running two system at the sometime is high. The workload of employee during conversion is almost doubled.

2. (a) Testing is a process of comparing actual result with expected result. It is to check whether the system is working appropriately or not.

Black box testing:
The test designer selects valid and invalid inputs and determines the correct output. If a module, performs a function which is not supposed to the black box text close not identify it as it is not concerned with the internal structure. Thus in black box testing, it has no relation with the interval functioning of a system.

White box testing:
White box testing uses an internal perspective of the system to design test cases based on internal structure. It requires programming skills to identify all paths through the software. After obtaining a clear picture of the internal workings of a product, tests can be conducted to ensure that the internal operation of the product conforms to specifications and all the internal components are adequately exercised.

Gray box testing:
Gray box testing is a software testing technique that used a combination of black box testing and white box testing. In gray box testing, the tester applies a limited

number of test cases of the internal workings of the software under test. In the remaining part of the gray box testing, one takes a black box approach in applying inputs to the software under test and observing the outputs.

(b) The advantages of DBMS are:

(i) **Data Sharing**:
It is very easy to share between users. Data from the entire company can be used by users who need them. Managers can analyze the data in a more extensive manner than in file management system.

(ii) **Reduced data redundancy**:
A database minimizes duplication of data from file to file. For example in a university database student's name and address may appear in only one record rather than in the files of many departments.

(iii) **Data Independence**:
A database system keeps data separate from the application that used the data. Thus, changes, can be made to data definitions without making changes to every application program that uses the data. Thus program maintenance costs (i.e., cost of upgrading application programs) can be substantially reduced.

(iv) **Increased User Productivity:**
In database environment user with minimum technical knowledge can also generate queries using query languages and can generate reports using report generators. To generate some queries / reports MIS departments take long period of time. Thus productivity of users also increase.

(v) Increased application programmer productivity:
Most database management systems offers application program development tools. With the help of these tools a programmers can write program application program development tools. With the help of these tools a programmers can write program code. These tools can be very powerful and can increase the productivity of programmer substantially.

(vi) Improved Data Integrity
Data redundancy is minimized data inconsistency and threat of non-integrated data are substantially decreased. Integrity means correctness of data.

(vii) Improved data administration & Control
In database environment the responsibility of protecting the database is placed in the hands of one person on department. It becomes easy to control access to data, privacy of data, updates, deletions of data etc.

(viii) Providing Backup and Recovery:
A DBMS most provide facilities for recovering from hardware or software failure. The backup and recovery subsystem of the DBMS is responsible for recovery.

3. (a) The Major features of an enterprise resource planning (ERP) are stated below:

(i) An ERP system is flexible enough to respond fast to the changing needs of the organization.
(ii) It supports various organizational functions. It has in depth features in accounting material management, sales and distribution management, human resource management etc.

(iii) It has end-to-end supply chain management to optimize the overall demand and supply.
(iv) It facilitates integrated information systems covering all functional areas like manufacturing procurement, sales and distribution, payables, receivables. Human resources, inventory and finance etc., and if bridges the information gap across organization.
(v) ERP is the solution for better project management.
(vi) It allows introduction of latest technologies like electronic funds transfer, electronic data interchange, internet, intranet, E-Commerce etc.,
(vii) It eliminates business problem like material shortage, productivity, customer service, cash management, quality and prompt delivery.
(viii) It provides intelligent business tools like decision support system, executive information system etc.
(ix) It provides multi-plate form, multi-facility, multi mode of manufacturing, multi-currency and multi-lingual facilities.
(x) It supports strategic and business planning activities, operational planning and execution activities, material and resource planning.

(b) The major characteristics of TPS are

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