**18ME702**

**Hall Ticket Number:**

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**IV/IV B.Tech (Regular/Supplementary) DEGREE EXAMINATION**

**November 2022** **Mechanical Engineering**

**Seventh Semester** **Operations Management**

**Time:** Three Hours **Maximum: 5**0 Marks

*Answer Question No. 1 Compulsorily.* (10X1 = 10 Marks)

*Answer **ANY ONE** question from each Unit.* (4X10=40 Marks)

| | | | | |
|---|---|---|---|---|
| 1. | a) | Define forecasting | CO1(BL1) | 1M |
| | b) | List any two Aggregate Planning strategies | CO1(BL1) | 1M |
| | c) | What is the difference between loading and scheduling | CO1(BL1) | 1M |
| | d) | List any two types of inventories | CO2(BL1) | 1M |
| | e) | What is P system in inventory management | CO2(BL1) | 1M |
| | f) | List any two contemporary management techniques | CO2(BL1) | 1M |
| | g) | What is the difference between assignable causes and chance causes | CO3(BL1) | 1M |
| | h) | What is the necessity of ISO 9000 2015 standards | CO3(BL1) | 1M |
| | i) | Define artificial variable | CO4(BL1) | 1M |
| | j) | What is degeneracy in transportation method | CO4(BL1) | 1M |
| | | **Unit - I** | | |
| 2. | a) | Explain any two quantitative forecasting techniques | CO1(BL2) | 5M |
| | b) | Write the basic features of Mass, Batch production systems. | CO1(BL1) | 5M |
| | | **(OR)** | | |
| 3. | a) | What is the role of aggregate planning in operations management | CO1(BL1) | 5M |
| | b) | Explain the different scheduling policies | CO1(BL2) | 5M |
| | | **Unit - II** | | |
| 4. | a) | Explain the different types of inventories | CO2(BL2) | 5M |
| | b) | Explain the problems in materials requirement planning | CO2(BL2) | 5M |
| | | **(OR)** | | |
| 5. | a) | Differentiate between P and Q systems | CO2(BL2) | 5M |
| | b) | Explain the fundamental philosophy of JIT | CO2(BL2) | 5M |
| | | **Unit - III** | | |
| 6. | a) | Explain the Taguchi Principles with respect to quality management | CO3(BL2) | 5M |
| | b) | What do you mean by acceptance sampling? How acceptance sampling operates? | CO3(BL1) | 5M |
| | | **(OR)** | | |
| 7. | a) | Explain the important features of TQM | CO3(BL2) | 5M |
| | b) | Describe the principles behind Six Sigma. | CO3(BL2) | |
| | | **Unit - IV** | | |
| 8. | | Solve the following LPP by using graphical method | CO4(BL3) | 10M |

Maximize $Z = 2x_1 + 3x_2$

Subjected to constraints

$2x_1+x_2 \leq 2$

$3x_1+4x_2 \geq 12$

$x_1, x_2 \geq 0$

**(OR)**

9. Solve the following transportation problem CO4(BL3) 10M

| | F1 | F2 | F3 | Supply |
|---|---|---|---|---|
| W1 | 2 | 7 | 4 | 5 |
| W2 | 3 | 3 | 1 | 8 |
| W3 | 5 | 4 | 7 | 7 |
| W4 | 1 | 6 | 2 | 14 |
| Demand | 7 | 9 | 18 | |

IV/IV B.Tech (Mech. Engg.) –7th sem, Regular Exam, Novc 2022

Sub: **OPERATIONS MANAGEMENT [18ME702]**

Scheme of valuation cum Solution set

1 1 x 10 = 10 M

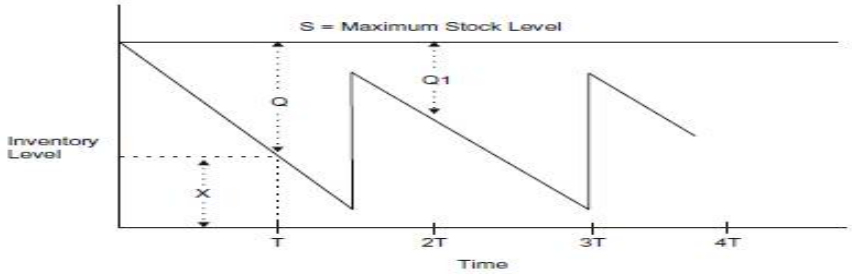
a) Define forecasting
Forecasts are estimates of occurrence, timing or magnitude of future events.

b) List any two Aggregate Planning strategies
Types of implementing Aggregate planning strategies:
1. Pure strategy
2. Mixed strategy

c) What is the difference between loading and scheduling
Loading - assignment of jobs to process centers. Loading is a type of scheduling that loads or packs work into available work time.
scheduling : determining the order in which jobs will be processed

d) List any two types of inventories
i. Raw materials inventory as input to manufacturing system.
ii. Bought-out-parts inventory which directly go to the assembly of product as it is.
iii. Work-in-progress or work-in-process inventory
iv. Finished goods inventory for supporting the distribution to the customers.
v. Indirect Inventories like maintenance, repair, and operating supplies.

e) What is P system in inventory management
- The stock status is periodically reviewed under this policy after a fixed time interval (T).




f) List any two contemporary management techniques
Lean, JIT, ERP and Supply chain Management.

g) What is the difference between assignable causes and chance causes
Chance causes of variability' are the common, inherent and naturally occurring variability of a process. It can be simply termed as the 'background noise' of the process.
"An assignable cause can be defined as a source of variation that is intermittent, not predictable". It is mentioned as a special cause.

h) What is the necessity of ISO 9000 2015 standards
ISO 9000:2015 specifies the terms and definitions that apply to all quality management and quality management system standards developed by ISO/TC 176.

i) Define artificial variable
The artificial variable refers to the kind of variable which is introduced in the linear program model to obtain the initial basic feasible solution

j) What is degeneracy in transportation method
In a transportation problem, if a basic feasible solution with m origins and n destinations has less than m +n -1 positive Xij i.e. occupied cells, then the problem is said to be a degenerate transportation problem.

**Unit - I**

2. a) Explain any two quantitative forecasting techniques CO1(BL2) 5M

1. Naive approach
2. Moving averages
3. Exponential smoothing
4. Trend projection

} **time-series models**

5. Linear regression } **associative model**

*Explanation of any two techniques with formulae and examples.*

b) Write the basic features of Mass, Batch production systems. CO1(BL1) 5M

*Batch production system is used under the following circumstances:*
1. When there is shorter production runs.
2. When plant and machinery are flexible.
3. When plant and machinery set up is used for the production of item in a batch and change of set up is required for processing the next batch.
4. When manufacturing lead time and cost are lower as compared to job order production.

*Mass production is used under the following circumstances*:
1. Standardization of product and process sequence.
2. Dedicated special purpose machines having higher production capacities and output rates.
3. Large volume of products.
4. Shorter cycle time of production.
5. Lower in process inventory.
6. Perfectly balanced production lines.
7. Flow of materials, components and parts is continuous and without any back tracking.
8. Production planning and control is easy.
9. Material handling can be completely automatic.

**(OR)**

3. a) What is the role of aggregate planning in operations management CO1(BL1) 5M

Aggregate planning is an operational activity which gives an overall plan for the production process, in advance of 2 to 18 months, to give an idea to management as to what quantity of materials and other resources are to be procured and when, so that the total cost of the organization is kept to the minimum over that period.

**Need for Aggregate Capacity Planning**

1. It facilitates fully loaded facilities and minimises overloading and underloading and keeps production cost low.
2. Adequate production capacity is provided to meet expected aggregate demand.
3. Orderly and systematic transition of production capacity to meet the peaks and valleys of expected customers demand is facilitated.
4. In times of scarce production resources, getting the maximum output for the amount of resources is enhanced.
5. To manage change in production/operations management by planning for resources that adopt to the changes in customer demands.

b) Explain the different scheduling policies CO1(BL2) 5M

Scheduling policies:

- FCFS - First Come, First Served
- SPT - Shortest Processing Time
- EDD - Earliest Due Date
- LPT - Longest Processing Time
- LS - Least Slack
- Rush - emergency

*Explanation of above policies briefly*

**Unit - II**

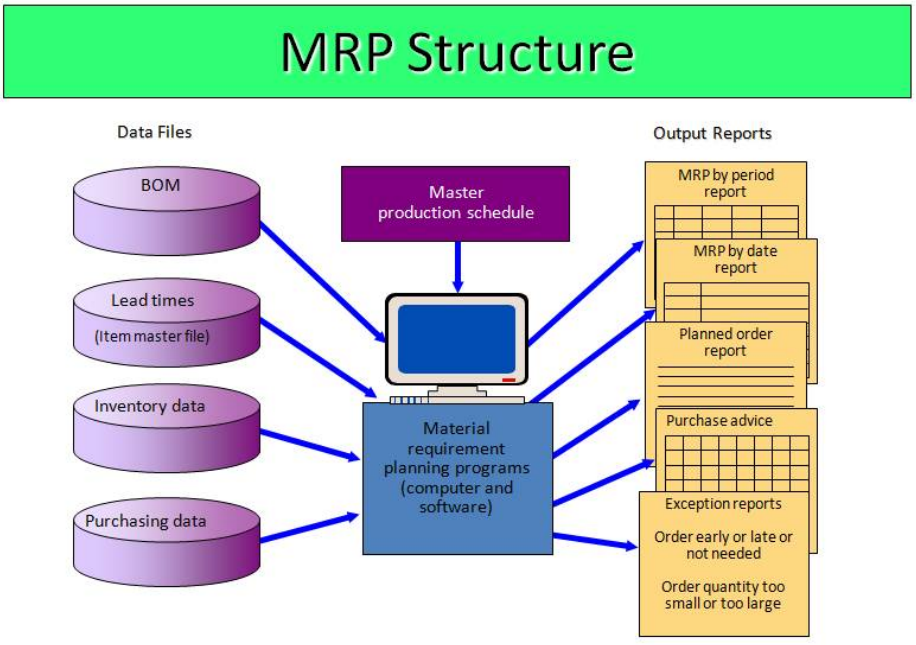
4. a) Explain the different types of inventories CO2(BL2) 5M

- Inventory is a usable but idle resource having some future economic value
- It is a physical resource that a firm holds in stock with the intent of selling it or transforming it into a more valuable state.
- It is stocked to ensure uninterrupted supplies
- Acts as cushion between estimated and actual demand of materials


Types of inventories:

(a) Raw materials inventory as input to manufacturing system.
(b) Bought-out-parts inventory which directly go to the assembly of product as it is.
(c) Work-in-progress or work-in-process inventory
(d) Finished goods inventory for supporting the distribution to the customers.
(e) Indirect Inventories like maintenance, repair, and operating supplies. These include spare parts, indirect materials, consumables and all other sundry items required for production/service systems.

b) Explain the problems in materials requirement planning CO2(BL2) 5M




**(OR)**

5. a) Differentiate between P and Q systems CO2(BL2) 5M

**Distinction between 'Q' and 'P' system**

| Point of Difference | Q System | P System |
|---|---|---|
| 1. Initiation of order | Stock on hand reaches to reorder point | Based on fixed review period and not on stock level |
| 2. Period of order | Any time when stock level reaches to reorder point | Only after the predetermined period |
| 3. Record Keeping | Continuously each time a withdrawal or addition is made | Only at the review period |
| 4. Order Quantity | Constant, the same quantity ordered each time | Quantity of order varies each time order is placed |
| 5. Size of Inventory | Less than the 'P' system | More than the 'Q' system |
| 6. Time to maintain | Higher due to perpetual record keeping | Less time due to only at the review period. |
| 7. Useful | Where financial resources are abundant and/or available at any time | Where financial resources are available at fixed intervals |
| 8. Advantageous | Where stock-out costs are high | For joint production/ transportation buying |
| 9. Cycle period and reorder period | Vary | Constant |
| 10. Cycle period and reorder period | Not equal | equal |

*Any 5 points*

b) Explain the fundamental philosophy of JIT CO2(BL2) 5M

*Just-in-time (JIT)*:

A highly coordinated processing system in which goods move through the system, and services are performed, just as they are needed.

Schonberger defines the JIT system as to :

"Produce and deliver finished goods just in time to be sold, sub-assemblies just in time to be assembled into finished goods, and purchased materials just in time to be transformed into fabricated parts".

Meet demand instantaneously: products and services are delivered (both to production & to the customer) only as and when they are needed...

...With the best appropriate quality, and no waste!

The ultimate goal of JIT is a balanced system. Achieves a smooth, rapid flow of materials through the system

Just-in-time (JIT) is an inventory strategy that strives to improve a business's return on investment by reducing in-process inventory and associated carrying costs.

The just-in-time inventory system focus is having "the right material, at the right time, at the right place, and in the exact amount", without the safety net of inventory.

The philosophy of JIT is simple: inventory is waste. JIT inventory systems expose hidden causes of inventory keeping, and are therefore not a simple solution for a company to adopt. The company must follow an array of new methods to manage the consequences of the change. The ideas in this way of working come from many different disciplines including statistics, industrial engineering, production management, and behavioral science. The JIT inventory philosophy defines how inventory is viewed and how it relates to management.

**Unit - III**

6. a) Explain the Taguchi Principles with respect to quality management CO3(BL2) 5M

Taguchi Method:

Taguchi Method is a new engineering design optimization methodology that

improves the quality of existing products and processes and simultaneously reduces their costs very rapidly, with minimum engineering resources and development man-hours. The Taguchi Method achieves this by making the product or process performance "insensitive" to variations in factors such as materials, manufacturing equipment, workmanship and operating conditions. Taguchi method makes the product or process robust and therefore is also called as ROBUST DESIGN

Taguchi's principle contributions to statistics are:

- Taguchi loss-function
- The philosophy of offline quality control
- Innovations in the design of experiments

Taguchi loss-function:

Adopted R A Fishers's methodology to improve mean outcome of process.

Excessive variation lay at the root of poor manufacturedquality.

Involved cost to society with cost of quality.

Industrial experiments seek to maximize an appropriate signal to noise ratio representing the magnitude of the mean of a process as compared to its variation.

The philosophy of off-line quality control: The best opportunity to eliminate variation is during design of a product and its manufacturing process

Innovations in the design of experiments: Outer arrays. An orthogonal array that seeks deliberately to emulate the sources of variation that a product would encounter in reality.

b) What do you mean by acceptance sampling? How acceptance sampling operates? CO3(BL1) 5M

- Acceptance Sampling: Accept or reject a lot (input components or finished products) based on inspection of a sample of products in the lot
- Tool for Quality Assurance
- Statistical quality control technique, where a random sample is taken from a lot, and upon the results of the sample taken the lot will either be rejected or accepted.
- Trend today is toward developing testing methods that are so quick, effective, and inexpensive that products are submitted to 100% inspection/testing
- Every product shipped to customers is inspected and tested to determine if it meets customer expectations
- But there are situations where this is either impractical, impossible or uneconomical
  - Destructive tests, where no products survive test
- In these situations, acceptance plans are sensible
- An acceptance plan is the overall scheme for either accepting or rejecting a lot based on information gained from samples.
- The acceptance plan identifies the:
  - Size of samples, n
  - Type of samples
  - Decision criterion, c, used to either accept or reject the lot
- Samples may be single, double, or sequential.

**(OR)**

7. a) Explain the important features of TQM. CO3(BL2) 5M

## TQM Philosophy

- TQM Focuses on identifying quality problem root causes
- Encompasses the entire organization
- Involves the technical as well as people
- Relies on seven basic concepts of
- Customer focus
- Continuous improvement
- Employee empowerment
- Use of quality tools
- Product design
- Process management
- Managing supplier quality

*Explanation of above points briefly.*

b) Describe the principles behind Six Sigma. CO3(BL2)

- **Six Sigma** seeks to improve the quality of process outputs by identifying and removing the causes of defects.
- **Six Sigma** approach is a collection of managerial and statistical concept and techniques that focuses on reducing variation in processes and preventing deficiencies in product.
- The concept of Variation states "NO two items will be perfectly identical."
- In a process that has achieved six sigma capability, the variation is small compared to the range of specification limit.
- A six sigma process is one in which **99.9999966%** of the products manufactured are statistically expected to be free of defects (**3.4 defects per million**).
- Six Sigma is a very clever way of branding and packaging many aspects of Total Quality Management (TQM).
( TQM is a management approach to long-term success through customer satisfaction.)
- Manufacturing methods of six sigma are used in Batch production, Job production & Mass production.

**Unit - IV**

8. Solve the following LPP by using graphical method CO4(BL3) 10M

Maximize $Z = 2x_1 + 3x_2$

Subjected to constraints

$2x_1+x_2 \leq 2$

$3x_1+4x_2 \geq 12$

$x_1, x_2 \geq 0$

**Solution** The following graph gives the regions represented by the constraints.

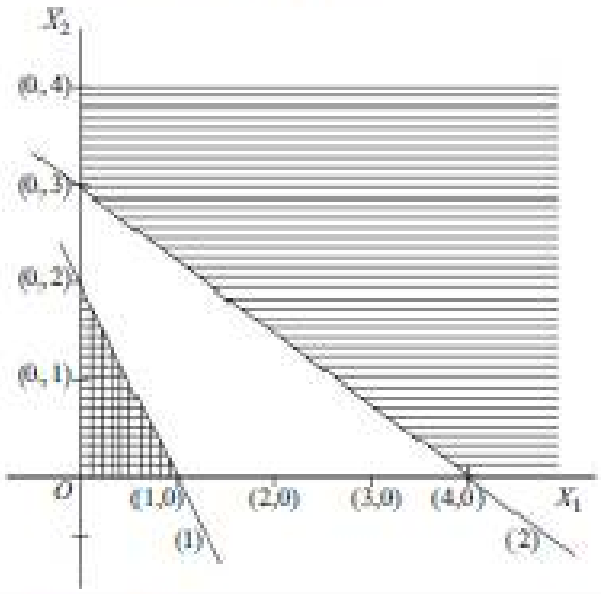



**Fig. 2.12**

From the graph we find that there is no common region between the two. That is to say that there is no point $(x_1, x_2)$ which satisfies both the constraints. Hence there is no feasible solution. Thus the given LPP has no solution.

**(OR)**

9. Solve the following transportation problem 10M CO4(BL3)

| | F1 | F2 | F3 | Supply |
|---|---|---|---|---|
| W1 | 2 | 7 | 4 | 5 |
| W2 | 3 | 3 | 1 | 8 |
| W3 | 5 | 4 | 7 | 7 |
| W4 | 1 | 6 | 2 | 14 |
| Demand | 7 | 9 | 18 | |

Initial feasible solution is

| | $F_1$ | $F_2$ | $F_3$ | Supply | Row Penalty |
|---|---|---|---|---|---|
| $W_1$ | 2**(3)** | 7**(2)** | 4 | 5 | 2 \| 2 \| 5 \| 5 \| 7 \| -- \| |
| $W_2$ | 3 | 3 | 1**(8)** | 8 | 2 \| -- \| -- \| -- \| -- \| -- \| |
| $W_3$ | 5 | 4**(7)** | 7 | 7 | 1 \| 1 \| 1 \| 1 \| 4 \| 4 \| |
| $W_4$ | 1**(4)** | 6 | 2**(10)** | 14 | 1 \| 1 \| 5 \| -- \| -- \| -- \| |
| Demand | 7 | 9 | 18 | | |
| Column Penalty | 1<br>1<br>1<br>3<br>--<br>-- | 1<br>2<br>2<br>3<br>3<br>4 | 1<br>2<br>--<br>--<br>--<br>-- | | |

The minimum total transportation cost $= 2 \times 3 + 7 \times 2 + 1 \times 8 + 4 \times 7 + 1 \times 4 + 2 \times 10 = 80$

Here, the number of allocated cells = 6 is equal to m + n - 1 = 4 + 3 - 1 = 6
∴ This solution is non-degenerate

Optimality test using modi method...
Allocation Table is

| | $F_1$ | $F_2$ | $F_3$ | Supply |
|---|---|---|---|---|
| $W_1$ | 2 **(3)** | 7 **(2)** | 4 | 5 |
| $W_2$ | 3 | 3 | 1 **(8)** | 8 |
| $W_3$ | 5 | 4 **(7)** | 7 | 7 |
| $W_4$ | 1 **(4)** | 6 | 2 **(10)** | 14 |
| Demand | 7 | 9 | 18 | |

| | $F_1$ | $F_2$ | $F_3$ | Supply | $u_i$ |
|---|---|---|---|---|---|
| $W_1$ | 2 **(5)** | 7 [2] | 4 [1] | 5 | $u_1 = 2$ |
| $W_2$ | 3 [3] | 3 **(2)** | 1 **(6)** | 8 | $u_2 = 0$ |
| $W_3$ | 5 [4] | 4 **(7)** | 7 [5] | 7 | $u_3 = 1$ |
| $W_4$ | 1 **(2)** | 6 [2] | 2 **(12)** | 14 | $u_4 = 1$ |
| Demand | 7 | 9 | 18 | | |
| $v_j$ | $v_1 = 0$ | $v_2 = 3$ | $v_3 = 1$ | | |

Since all $d_{ij} \geq 0$.

So final optimal solution is arrived.

| | $F_1$ | $F_2$ | $F_3$ | Supply |
|---|---|---|---|---|
| $W_1$ | 2 **(5)** | 7 | 4 | 5 |
| $W_2$ | 3 | 3 **(2)** | 1 **(6)** | 8 |
| $W_3$ | 5 | 4 **(7)** | 7 | 7 |
| $W_4$ | 1 **(2)** | 6 | 2 **(12)** | 14 |
| Demand | 7 | 9 | 18 | |

The minimum total transportation cost $= 2 \times 5 + 3 \times 2 + 1 \times 6 + 4 \times 7 + 1 \times 2 + 2 \times 12 = 76$

******THE END******

**Prepared by**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