



<b>Date :</b>	<b>Improvement CIE</b>	<b>Max. Marks : 10 + 50</b>
<b>Semester : III</b>	<b>UG</b>	<b>Duration : 30 + 90 Min</b>
<b>Course Title: Work Systems Design</b>		<b>Course Code : IM233AI</b>

## SCHEME & SOLUTIONS

Sl. No	Solutions with Scheme	M
Part – A		
1.	Production refers to the total output or quantity of goods/services produced.  <u>Productivity is the ratio of output to input, measuring efficiency (e.g., units produced per labor hour).</u>	2
2.	Manual Work Systems – tasks performed entirely by human effort.  Worker–Machine Systems – humans operate machines.  <u>Automated Systems – machines perform tasks with minimal human input.</u>	2
3.	Just-in-Time (JIT): Producing only what is needed, when needed.  <u>Jidoka (Autonomation): Automation with a human touch—stopping for defects to ensure quality.</u>	2
4.	Muda – Waste  Mura – Unevenness  Muri – Overburden.	2
5.	1. Seiri – Sort 2. Seiton – Set in order 3. Seiso – Shine 4. Seiketsu – Standardize 5. Shitsuke – Sustain	2
Part – B		
1.	Productive work content vs Non productive work content with illustrations....5m  Reasons for Non-Productive Work Content:5m  1. Poor Method Design <ul style="list-style-type: none"><li>o E.g., Worker walks 10 meters to fetch parts due to poor layout.</li></ul> 2. Inefficient Workplace Layout <ul style="list-style-type: none"><li>o E.g., Tools placed far from point of use.</li></ul> 3. Inadequate Tools or Equipment <ul style="list-style-type: none"><li>o E.g., Using manual tools instead of power tools increases time.</li></ul> 4. Defective Materials or Rework <ul style="list-style-type: none"><li>o E.g., Time spent correcting errors due to poor quality inputs.</li></ul> 5. Lack of Standardization <ul style="list-style-type: none"><li>o E.g., Workers perform tasks differently, leading to inconsistency.</li></ul>	10
2.	To solve for the standard time, we first need to establish the basic components of the work cycle and the impact of the irregular element (changing tote pans).  Identify Core Components	10



Machine Cycle Time: 2.83 min

Manual Load/Unload: 24 seconds = 0.40 min

Irregular Element (Tote Pans): 2.40 min every 6 cycles.

Pro-rated Irregular Time = 0.40 per cycle.

Allowances Apfd = 15%, Machine = 15%

(a) Irregular element performed as an extra element

In this scenario, we assume the machine stops while the operator changes the tote pans. The irregular element is added to the total normal time of the cycle.

Step 1: Calculate Normal Time per cycle

$$= 0.40 + 2.83 + 0.40 = 3.63 \text{ min}$$

Step 2: Apply Allowances

Since there are different allowances for manual and machine work, we apply them to their respective portions:

Manual Portion: 0.92 min

Machine Portion: 3.2545 min

$$\text{Standard Time: } 0.92 + 3.2545 = 4.1745 \text{ min}$$

(b) Irregular element performed as an internal element

In this scenario, the operator replaces the tote pans while the machine is running. This is possible if the machine cycle (2.83 min) is longer than the time required for the irregular element (2.40 min).

Step 1: Determine the Governing Cycle Time

Since  $2.40 < 2.83$ , the operator can complete the tote pan change during the machine's "automatic" phase. The irregular element effectively "disappears" into the machine time for 5 out of 6 cycles. However, we must ensure the standard accounts for the fact that the machine is the bottleneck.

$$\text{Step 2: Calculate Normal Time } 0.40 + 2.83 = 3.23 \text{ min}$$

Step 3: Apply Allowances

Manual Portion: 0.46 min

Machine Portion: 3.25 min

$$\text{Standard Time: } 0.46 + 3.2545 = 3.7145 \text{ min.}$$



3.	<ol style="list-style-type: none"><li>1. Overproduction – Making more than needed<ul style="list-style-type: none"><li>o E.g., Producing 100 units when demand is 80</li></ul></li><li>2. Waiting – Idle time due to delays<ul style="list-style-type: none"><li>o E.g., Waiting for materials or approvals</li></ul></li><li>3. Transportation – Unnecessary movement of materials<ul style="list-style-type: none"><li>o E.g., Moving parts between distant workstations</li></ul></li><li>4. Overprocessing – Doing more than required<ul style="list-style-type: none"><li>o E.g., Excess polishing beyond specification</li></ul></li><li>5. Inventory – Excess raw materials or WIP<ul style="list-style-type: none"><li>o E.g., Stockpiling components not immediately needed</li></ul></li><li>6. Motion – Unnecessary movement by workers<ul style="list-style-type: none"><li>o E.g., Reaching or bending repeatedly</li></ul></li><li>7. Defects – Rework or scrap due to quality issues<ul style="list-style-type: none"><li>o E.g., Incorrect drilling requiring rework</li></ul></li></ol> <p>Explanation: 7m . If examples are discussed...3m</p>	10
4.	<ol style="list-style-type: none"><li>1. Stable Production Schedule<ul style="list-style-type: none"><li>o Enables predictable demand and smooth flow</li><li>o E.g., Level scheduling (Heijunka) reduces variability</li></ul></li><li>2. Reliable Suppliers and Quality Inputs<ul style="list-style-type: none"><li>o Ensures timely delivery of defect-free materials</li><li>o E.g., Supplier partnerships and frequent deliveries</li></ul></li><li>3. Flexible Workforce and Equipment<ul style="list-style-type: none"><li>o Multi-skilled workers and quick changeovers support responsiveness</li><li>o E.g., Cross-training and SMED (Single-Minute Exchange of Dies)</li></ul></li></ol> <p>Explanation: 6m</p> <p>Analysis: 4m These prerequisites reduce lead time, minimize inventory, and support continuous flow—core to JIT success.</p>	10
5.	<ol style="list-style-type: none"><li>1. Takt Time<ul style="list-style-type: none"><li>o The rate at which products must be produced to meet customer demand</li><li>o E.g., If demand is 480 units/day and 480 minutes/day, takt time = 1 min/unit</li></ul></li><li>2. Work Sequence<ul style="list-style-type: none"><li>o The exact order of operations performed by the worker</li><li>o E.g., Pick part → Load → Start machine → Inspect → Unload</li></ul></li><li>3. Standard Work-in-Process (SWIP)<ul style="list-style-type: none"><li>o Minimum inventory required to keep the process flowing smoothly</li><li>o E.g., 2 parts between stations to prevent idle time</li></ul></li></ol> <p>The answer could also include : Cycle Time, Work Sequence and SWIP.</p> <p>Explanation:3+3+4m These components ensure consistency, reduce variability, and form the foundation for continuous improvement in Lean systems.</p>	10



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