



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination (C-23) in Engineering: March 2026

Module Number: ME5204 Module Name: Production Planning and Control

[Three Hours]

[Answer all questions, each question carries twelve (12) marks]

- Q1.** Alpha Manufacturing (Pvt.) Ltd., a diversified manufacturing enterprise, operates through four distinct production divisions, each specialising in different product lines and contributing to the company's overall operational performance.

Division A :

Produces packaged fruit juice continuously for long hours, with occasional stops for cleaning and maintenance. The output is highly standardised and produced in large volumes.

Division B :

Manufactures recycled plastics using automated machines to produce juice bottles. The same design is produced in extremely high quantities with very little variation, and production rarely changes.

Division C :

Produces juice makers with different capacities such as 50L, 100L and 250L. Orders are grouped by design, and after completing one group, machines are adjusted to produce a different design.

Division D :

Undertakes specialised repair and fabrication of heavy machinery components. Each task is different, requires skilled labour, and is performed according to specific customer requirements.

- a) Identify the most appropriate production system for each division.
[2.0 Marks]
- b) Justify the selections of Q1. (a) by clearly explaining the underlying operational characteristics.
[4.0 Marks]
- c) Determine whether qualitative or quantitative forecasting methods are most appropriate for each division.
[2.0 Marks]
- d) Identify the most suitable plant layout for each division and justify your choice based on operational requirements and production characteristics.
[4.0 Marks]

- Q2.** A medium-scale garment manufacturing company in Sri Lanka, which relies heavily on imported raw materials and diesel-powered transportation for its supply chain operations, is currently facing significant disruptions due to ongoing fuel shortage. As a result, the supplier deliveries have been delayed, transportation costs have escalated, and production schedules have become increasingly unstable.

The company had previously adopted Just-in-Time inventory strategy, maintaining minimal stock levels to enhance efficiency and reduce holding costs. However, under the present conditions, this approach has become increasingly unsustainable, leading to frequent stockouts of essential materials such as fabric and accessories, thereby adversely affecting overall operational performance.

The annual demand for a specific type of fabric is estimated at 12,000 metres. Owing to transportation-related disruptions, the ordering cost has risen to LKR 1,500 per order, while the inventory holding cost is estimated at LKR 5 per metre per annum.

- a) Identify **two** inventory categories that the company should increase in response to the current fuel shortage. Justify the selection based on the given operational context.
[3.0 Marks]
- b) Explain how the prevailing fuel shortage influences any **three** components of inventory-related costs within the supply chain.
[3.0 Marks]
- c) Recommend a suitable inventory control strategy or model that could adopt to manage uncertainty more effectively. Briefly explain how this approach would improve operational stability.
[3.0 Marks]
- d) Determine the **optimal order quantity** that minimises the total inventory cost.
[3.0 Marks]

- Q3.** A consumer electronics manufacturer operates in a highly dynamic environment, producing smartphones and wearable devices with frequent product upgrades and variable production volumes. This necessitates adaptable production systems and responsive operational strategies to effectively manage demand variability and technological change.

- a) Briefly explain **two** key goals of assembly lines in a manufacturing system.
[2.0 Marks]
- b) Explain the strategic importance of adopting a flexible assembly line within this industry.
[2.0 Marks]
- c) Global Appliances Ltd. is preparing to commence the production of a new refrigerator model. The management team is currently engaged in optimising workflow distribution across various workstations involved in the production process. The assembly process comprises 12 sequential operations, as illustrated in **Figure Q3**. To satisfy production targets, the company is required to achieve an output rate of one refrigerator in every 15 minutes.

Q3. Continues to the next page

- i) Explain the **two** conditions that must be satisfied when assigning work elements to workstations and discuss why these conditions are critical for effective assembly line balancing. [2.0 Marks]
- ii) Assign the given work elements to appropriate workstations using **Largest Candidate Rule**. [4.0 Marks]
- iii) Determine the line efficiency and the corresponding balance delay. [2.0 Marks]

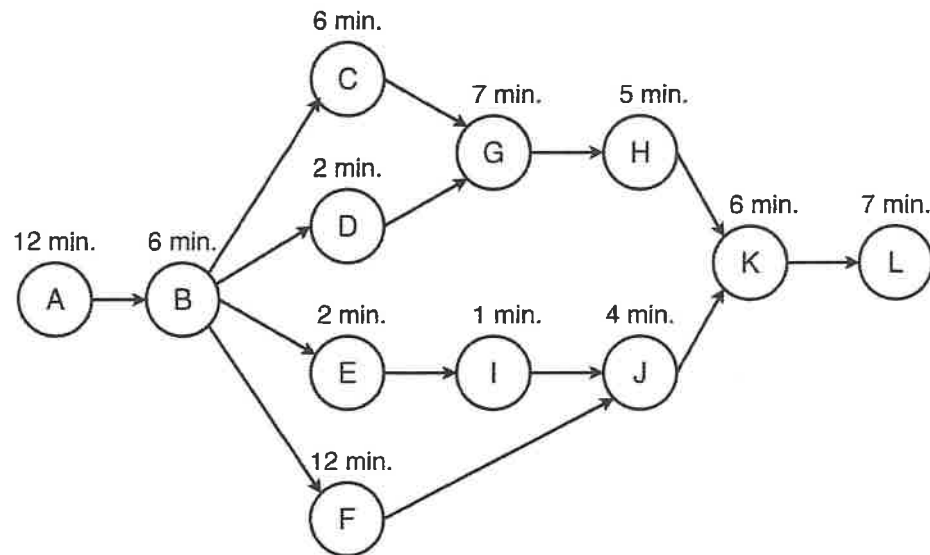


Figure Q3 : Precedence Diagram of the Assembly Process

- Q4. a)** A fuel distribution company in Sri Lanka is responsible for supplying diesel to five regional filling stations : A, B, C, D, and E amid an ongoing fuel shortage. Owing to constrained logistics capacity, the distribution process is structured into two sequential stages:

Stage 1 : Fuel loading at the central depot

Stage 2 : Transportation to and unloading at the respective filling station

Each station must be serviced strictly in the sequence **Stage 1** followed by **Stage 2**, and at each stage, only one station can be processed at a time, reflecting a two-machine flow shop environment. The corresponding processing times (*in hours*) for each stage are provided in Table Q4.

Table Q4 : Processing Times for Fuel Loading and Delivery Operations

Station	Loading Time /hr	Delivery Time /hr
A	6	3
B	2	7
C	8	5
D	4	9
E	7	2

- i) Determine the optimal sequence of fuel deliveries that minimises the total distribution time.

[2.0 Marks]

- ii) Calculate the total elapsed time required to complete all deliveries based on the optimal sequence.

[4.0 Marks]

- b) A garment manufacturing company, engaged in fulfilling orders for buyers in the United States and Germany, operates a production facility in Katunayake.

Due to fluctuating international demand and highly strict shipment deadlines, the company is required to develop **Master Production Schedule (MPS)** to effectively plan its weekly production activities.

In formulating the **Master Production Schedule**, the company must account for several operational constraints, including:

- Limited machine capacity, restricting production throughput
- Labour availability, which is influenced by seasonal workforce fluctuations
- Delays in imported fabric supplies, affecting material availability
- Frequent power interruptions, disrupting production continuity
- Compliance with strict labour regulations, limiting operational flexibility
- Firmly committed orders, necessitating adherence to delivery schedules

- i) Explain how the implementation of a **Master Production Schedule (MPS)** can support the garment manufacturing facility in effectively managing its production commitments and meeting stringent delivery deadlines.

[3.0 Marks]

- ii) Recommend **two** strategies that the company can adopt to enhance the effectiveness of its Master Production Schedule and ensure the reliability and consistency of its export operations.

[3.0 Marks]

- Q5. a)** Tropical Beverages, a leading soft drink manufacturer, currently operates a bottling facility in Colombo and is planning to establish an additional plant in the Central Province to accommodate rising market demand.

- i) Discuss **two** advantages of selecting the proposed location for establishing the new bottling facility.

[2.0 marks]

- ii) Briefly explain the key stages involved in the facility planning process.

[3.0 marks]

- iii) Explain the function of each stage with reference to the given scenario.

[3.0 marks]

Q5. Continues to the next page

- b) The company is currently evaluating the financial feasibility of establishing the new plant through a **Break-Even Analysis**. The associated cost parameters are provided in Table Q5 , and each bottle of soft drink is sold at a price of LKR 150.

Table Q5 : Fixed and Variable Cost Components for Soft Drink Production

Fixed Costs (LKR)		Variable Costs (LKR) (per unit)	
General Labor	750,000	Fruits	50
Utilities	30,000	Sugar	20
Insurance	20,000	Water	10
Advertising	85,000	Preservatives	15

- i) Explain the concept of **break-even analysis** and discuss its significance in supporting managerial decision-making in this context. [2.0 marks]
- ii) Determine the **break-even quantity** and interpret the result in relation to the company's operational and financial feasibility. [2.0 marks]