GUJARAT TECHNOLOGICAL UNIVERSITY

BE-6 SEMESTER – OLD PAPER – S22 TO S26 – ANSWER BANK

Subject Name & Code: BASICS OF INDUSTRIAL ENGINEERING - 3161907

Chapter 1: Location Selection and Plant Layout

Repeated Questions:

1. Plant Location:

- **Q.** Discuss the factors to be considered for the location of the thermal power plant. **(SUMMER 2023, 7 Marks; SUMMER 2025, 7 Marks)**

Answer:

Factors for Thermal Power Plant Location:

- **Availability of Fuel:** Continuous supply of coal/lignite at reasonable cost is essential. Plant should be located near coal mines to minimize transportation cost (e.g., Neyveli, Singrauli).
- **Water Supply:** Large quantity of water required for steam generation and cooling. Plant should be near rivers, lakes, or reservoirs.
- **Transportation Facilities:** Adequate rail/road connectivity for coal, equipment, and manpower movement. Nearness to railway sidings is preferred.
- **Land Availability:** Large area required for boiler house, turbine hall, coal storage, ash disposal, and future expansion. Land should be level and have good bearing capacity.
- **Ash Disposal:** Large quantity of ash generated requires nearby disposal sites or utilization industries (cement, bricks).
- **Proximity to Load Center:** Located near industrial areas/cities to minimize transmission losses and cost of power distribution.
- **Environmental Considerations:** Away from residential areas to minimize pollution (air, noise, thermal). Compliance with environmental regulations.
- **Climatic Conditions:** Moderate climate reduces cooling tower load. Avoid earthquake-prone zones.

- **Q.** List the factors that influence the selection of a plant location. / What are the factors deciding the location of a Plant? **(WINTER 2022, 3 Marks; SUMMER 2025, 3 Marks)**

Answer:

Factors Influencing Plant Location:

- **Availability of Raw Materials:** Proximity to sources reduces transportation cost.
- **Nearness to Market:** Reduces distribution cost and improves customer service.
- **Transport Facilities:** Rail, road, water, and air connectivity.
- **Availability of Labour:** Skilled and unskilled workforce at reasonable wages.
- **Availability of Power and Water:** Continuous supply for manufacturing operations.
- **Government Policies:** Tax incentives, subsidies, industrial zones.
- **Climatic and Environmental Factors:** Suitable weather conditions.
- **Land Availability and Cost:** Adequate space at reasonable price.

---

2. Plant Layout:

- **Q.** Differentiate between product layout and process layout. **(WINTER 2022, 7 Marks; SUMMER 2023, 3 Marks; WINTER 2023, 4 Marks; SUMMER 2024, 7 Marks; WINTER 2025, 4 Marks)**

Answer:
Comparison: Product Layout vs Process Layout:

Basis	Product Layout (Line Layout)	Process Layout (Functional Layout)
Definition	Machines arranged according to sequence of operations for a product.	Similar machines grouped together in departments based on function.
Type of Production	Mass/continuous production of standardized products.	Job/batch production of variety of products.
Material Flow	Continuous and unidirectional.	Intermittent and varied (backtracking possible).
Machine Utilization	High (dedicated machines).	Lower (general purpose machines shared).
Flexibility	Low; difficult to change product design.	High; easy to handle variety of products.
Example	Automobile assembly line, TV manufacturing.	Machine shop, job order fabrication shop.

- **Q.** What type of layout is used in Shipbuilding? Justify your answer. **(SUMMER 2024, 4 Marks; WINTER 2024, 4 Marks)**

Answer:
Layout Used in Shipbuilding: Fixed Position Layout

Justification:

- **Product is Stationary:** Ship is too large and heavy to be moved during construction; it remains at one location (dry dock/slipway).
- **Men and Machines Move:** Workers, equipment, and materials are brought to the ship construction site.
- **Low Production Volume:** Ships are custom-built, one at a time; not suitable for line or batch production.
- **High Variety:** Each ship has unique design and specifications; requires flexible arrangement.
- **Material Handling:** Cranes and transport equipment move materials to the fixed product location.

- **Q.** State the objectives of good plant layout. **(SUMMER 2022, 3 Marks; WINTER 2024, 3 Marks)**

Answer:
Objectives of Good Plant Layout:

- **Minimize Material Handling Cost:** Reduce distance and time of material movement.
- **Efficient Space Utilization:** Maximum utilization of available floor area.
- **Smooth Work Flow:** Ensure continuous and uninterrupted production flow.
- **Improved Productivity:** Reduce delays, bottlenecks, and idle time.
- **Safety and Comfort:** Provide safe working conditions and employee comfort.
- **Flexibility:** Allow for future expansion and product changes.

Other Important Questions:

1. Plant Location:

- **Q.** Explain the importance of plant location in brief. **(WINTER 2025, 3 Marks)**

Answer:
Importance of Plant Location:

- **Cost Reduction:** Proper location minimizes transportation, labour, and utility costs, directly affecting production cost.
- **Competitive Advantage:** Nearness to market enables faster delivery and better customer service.
- **Operational Efficiency:** Availability of skilled labour, power, and water ensures smooth operations.
- **Long-term Impact:** Location decision is irreversible and affects fixed costs permanently; wrong selection leads to perpetual losses.
- **Expansion Scope:** Adequate land and infrastructure allow future growth.

- **Q.** Enlist the objectives of plant location selection. **(SUMMER 2026)**

Answer:
Objectives of Plant Location Selection:

- Minimize total production and distribution cost.
- Maximize return on investment.
- Ensure availability of raw materials, labour, and utilities.
- Facilitate future expansion and diversification.
- Minimize environmental impact and comply with regulations.
- Achieve proximity to market for competitive advantage.

- **Q.** From the following data, select the site which is suitable for plant location considering the rate of return method: [Diagram required – refer to the original question paper] **(WINTER 2023, 7 Marks)**

Answer:
[Answer not available in the chat text; the data table is in the original question paper. Add the numerical solution here.]

- **Q.** A company has to choose one of three locations on the basis of the given data. Suggest a suitable location and justify. [Diagram required – refer to the original question paper] **(SUMMER 2025, 7 Marks)**

Answer:
[Answer not available in the chat text; the data table is in the original question paper. Add the numerical solution here.]

- **Q.** Discuss the factors to be considered for the location of the nuclear power plant. **(WINTER 2025, 7 Marks)**

Answer:
Factors for Nuclear Power Plant Location:

- **Safety and Seismic Zone:** Must be located in low seismic activity zones (Zone II or III). Avoid fault lines and earthquake-prone areas.
- **Availability of Cooling Water:** Large quantity of water required for reactor cooling. Nearness to sea, river, or large reservoir is essential.
- **Population Density:** Should be away from densely populated areas (minimum exclusion zone of 1.6 km and sterilization zone of 5 km). Low population density in surrounding region.
- **Land Availability:** Large area required for reactor building, turbine hall, waste storage, and safety zones. Land should have good bearing capacity.
- **Transportation Facilities:** Heavy equipment (reactor vessels) require special transport arrangements. Rail/road connectivity essential.
- **Grid Connectivity:** Nearness to load centers or transmission grid to minimize power transmission losses and cost.
- **Environmental Considerations:** Proper disposal of radioactive waste. Adequate atmospheric dispersion conditions. Away from flood-prone areas.
- **Security:** Remote location with controlled access for safety and security of nuclear installations.

- **Q.** Discuss the various factors to be considered for selection of site for Cement manufacturing plant. **(SUMMER 2026)**

Answer:
Factors for Cement Plant Location:

- **Nearness to Limestone Deposits:** Limestone is the major raw material (60-65%). Plant should be located near limestone quarries to minimize transport cost.
- **Availability of Coal:** Coal is required for kiln firing. Proximity to coal mines reduces fuel cost.
- **Transportation Facilities:** Cement is bulky; rail/road connectivity essential for raw material and finished product movement.
- **Water Supply:** Large quantity of water required for cooling and processing. Nearness to rivers/lakes.
- **Power Supply:** Cement plants are power-intensive. Continuous power supply at reasonable rates is essential.
- **Nearness to Market:** Cement is consumed widely in construction; location near major markets reduces distribution cost.
- **Land Availability:** Large area required for plant, storage, and quarrying. Land should be relatively cheap.
- **Environmental Considerations:** Dust and noise pollution control. Away from residential areas. Compliance with environmental norms.

---

2. Plant Layout – Factors, Tools and Impact:

- **Q.** List the different factors affecting plant layouts. Explain any three factors. **(SUMMER 2022, 4 Marks)**

Answer:
Factors Affecting Plant Layout:

- Type of production (job, batch, mass)

- Volume of production
- Nature of product (size, weight, shape)
- Availability of space
- Material handling equipment
- Type of machinery
- Working conditions and safety
- Future expansion plans

Explanation of Any Three Factors:

- **Type of Production:** Job production requires process layout (grouped by function); mass production requires product layout (arranged in line).
- **Material Handling Equipment:** Availability of cranes, conveyors, or trucks influences arrangement. Heavy materials require specific handling systems affecting layout design.
- **Nature of Product:** Large, heavy products (ships, aircraft) require fixed position layout; small, standardized products suit product layout.

- **Q.** Enlist the factors influencing plant layout. **(SUMMER 2024, 3 Marks)**

Answer:

Factors Influencing Plant Layout:

- Type of production (job, batch, mass)
- Volume of production
- Nature of product (size, weight, shape)
- Availability of space
- Material handling equipment
- Type of machinery
- Working conditions and safety
- Future expansion plans

- **Q.** Describe the impact of material handling considerations on plant layout. **(SUMMER 2025, 4 Marks)**

Answer:

Impact of Material Handling on Plant Layout:

- **Layout Arrangement:** Layout must be designed to minimize material travel distance. Machines arranged in sequence of operations to reduce handling.
- **Equipment Selection:** Type of handling equipment (conveyors, cranes, forklifts) determines aisle width, ceiling height, and floor loading requirements.
- **Cost Reduction:** Efficient layout reduces material handling cost which accounts for 20-50% of production cost.
- **Space Allocation:** Adequate space for aisles, storage, and loading/unloading areas must be provided in layout planning.
- **Safety:** Layout must ensure safe material movement without congestion or hazards.

- **Q.** Which are the different analytical tools of plant layouts? **(SUMMER 2022, 3 Marks)**

Answer:

Analytical Tools for Plant Layout:

- **From-To Chart:** Matrix showing material flow between departments.
- **Relationship Chart (REL Chart):** Shows closeness rating between departments.
- **Load-Distance Analysis:** Compares alternative layouts by calculating material movement cost.
- **Systematic Layout Planning (SLP):** Step-by-step procedure for layout design.
- **Travel Chart:** Shows number of trips between locations.

---

3. Types of Layout and Flow Charts:

- **Q.** Name various types of plant layouts. Explain any two with neat sketch. **(SUMMER 2022, 7 Marks)**

Answer:

Types of Plant Layout:

- Product Layout (Line Layout)
- Process Layout (Functional Layout)
- Fixed Position Layout
- Combination Layout (Hybrid Layout)

Explanation of Any Two:

1. Product Layout:

- Machines and equipment arranged according to sequence of operations for a single product.
- Suitable for mass production of standardized products.
- Smooth, continuous flow; high efficiency; low unit cost.
- Lack of flexibility; breakdown stops entire line.

Diagram Description: A straight line arrangement showing: Raw Material → Lathe → Milling → Drilling → Grinding → Assembly → Finished Product. Arrows indicate unidirectional flow.

2. Process Layout:

- Similar machines grouped together in departments (e.g., all lathes in one section).
- Suitable for job order and batch production.
- High flexibility; handles variety of products.
- Material backtracking and long flow paths possible.

Diagram Description: Rectangular blocks arranged in a grid showing: Lathe Section | Milling Section | Drilling Section | Grinding Section | Assembly Section. Arrows show materials moving between different sections based on product requirements.

- **Q.** Explain process layout. **(SUMMER 2026)**

Answer:

Process Layout (Functional Layout):

Definition: A layout in which similar machines and operations are grouped together in departments based on their function.

Characteristics:

- Machines of same type are placed in one department (e.g., all lathes together).
- Suitable for job order and batch production of varied products.
- High flexibility to handle different products.
- Material moves between departments based on processing sequence.

Example: Machine shop where lathe section, milling section, and drilling section are separate.

- **Q.** Explain the flow process chart (material type) with a suitable example. **(WINTER 2025, 4 Marks)**

Answer:

Flow Process Chart (Material Type):

Definition: A chart showing the sequence of operations, inspections, transportations, delays, and storages of a material as it moves through the production process.

Symbols Used:

- ○ Operation
- □ Inspection
- → Transportation
- D Delay
- ▽ Storage

Example: Steel bar moving through a machine shop:

Step	Activity	Symbol	Description
1	Storage	▽	Steel bars stored in raw material store
2	Transport	→	Moved to cutting section
3	Operation	○	Cut to required length
4	Transport	→	Moved to lathe section
5	Operation	○	Turning operation
6	Inspection	□	Dimensional check
7	Transport	→	Moved to finished goods store
8	Storage	▽	Stored as finished component

Purpose: Identifies non-value-adding activities (transport, delay, storage) to improve process efficiency.
