GUJARAT TECHNOLOGICAL UNIVERSITY

BE-5 SEMESTER – OLD PAPER – S22 TO S26 – ANSWER BANK

Subject Name & Code: Manufacturing Technology - 3151912

Chapter 1: Introduction to Manufacturing Technology

Repeated Questions:

1. Classification of Manufacturing Processes:

- **Q.** Classify manufacturing processes. **(WINTER 2022, 3 Marks; WINTER 2023, 3 Marks; WINTER 2024, 3 Marks)**

Answer:

Classification of Manufacturing Processes:

- **Casting Processes** – Pouring molten metal into moulds (Sand casting, Die casting, Investment casting)
- **Metal Joining Processes** – Joining materials permanently (Welding, Brazing, Soldering, Adhesive bonding)
- **Forming Processes** – Deforming material into desired shape (Rolling, Forging, Extrusion, Drawing)
- **Machining/Removal Processes** – Removing material to achieve final shape (Turning, Milling, Drilling, Grinding)
- **Surface Finishing Processes** – Improving surface quality (Lapping, Honing, Polishing, Buffing)
- **Plastic Processing** – Shaping polymers (Injection moulding, Blow moulding, Extrusion)

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2. Definition of Manufacturing Processes:

- **Q.** Define Manufacturing processes and enlist various manufacturing processes. **(SUMMER 2022, 3 Marks; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks)**

Answer:

- **Definition:** Manufacturing processes are the set of operations and techniques used to transform raw materials into finished products with desired shape, size, and properties.

Various Manufacturing Processes:

- **Casting** – Sand casting, Die casting, Investment casting
- **Welding** – Arc welding, Gas welding, Resistance welding
- **Forming** – Rolling, Forging, Extrusion, Wire drawing
- **Machining** – Turning, Milling, Drilling, Grinding
- **Surface Finishing** – Lapping, Honing, Buffing, Burnishing
- **Plastic Processing** – Injection moulding, Blow moulding, Thermoforming

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3. Selection of Manufacturing Process:

- **Q.** Discuss the factors for selecting a manufacturing process. / How is the selection of manufacturing process influenced by material and quantity? **(SUMMER 2022, 4 Marks; WINTER 2023, 3 Marks; SUMMER 2026, 3 Marks)**

Answer:

Factors for Selecting a Manufacturing Process:

Factor	Description
Material	Type, properties, and machinability of raw material (e.g., cast iron → casting; steel → forging/welding)
Quantity	Mass production favors die casting/automation; small batches favor sand casting/general machining
Geometry/Shape	Complex internal cavities → casting; simple shapes → machining/forming
Tolerances & Surface Finish	High precision requires machining/grinding; rough surfaces can use casting/forging
Cost	Tooling cost, labor cost, and material waste influence process economics
Mechanical Properties	Forging improves strength; casting provides isotropic properties

Material & Quantity Influence:

- **Material:** Brittle materials (cast iron) → casting; Ductile materials (steel, aluminum) → forming/welding
- **Quantity:** High volume → automated processes (die casting, injection moulding); Low volume → flexible processes (sand casting, manual welding)

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4. Significance of Manufacturing Processes:

- **Q.** What is the significance of Manufacturing processes for recent development? **(WINTER 2024, 3 Marks; SUMMER 2026, 4 Marks)**

Answer:

Significance of Manufacturing Processes:

- **Economic Growth** – Manufacturing contributes to GDP and creates employment opportunities
- **Technological Advancement** – Enables production of complex components for aerospace, automotive, and electronics industries
- **Quality of Life** – Provides consumer goods, medical devices, and infrastructure for modern living
- **Innovation** – Supports development of new materials and products (e.g., lightweight alloys, composites)
- **Global Competitiveness** – Efficient manufacturing processes reduce costs and improve product quality for international markets

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5. Types of Patterns:

- **Q.** List out types of Pattern and explain any three pattern with a neat sketch. **(WINTER 2022, 4 Marks; WINTER 2025, 4 Marks)**

Answer:

Types of Patterns:

- Solid/Single-piece pattern
- Split pattern

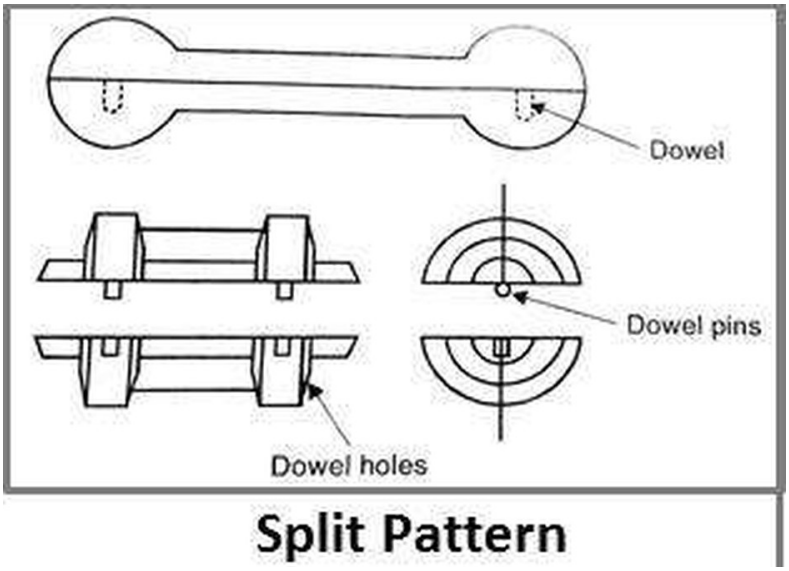
- Match plate pattern
- Cope and drag pattern
- Gated pattern
- Sweep pattern
- Skeleton pattern
- Loose piece pattern

Explanation of Three Patterns:

1. Split Pattern:

- Divided into two halves along the parting line
- Upper half (cope) and lower half (drag) are moulded separately
- Used for complex shapes that cannot be withdrawn from mould as single piece

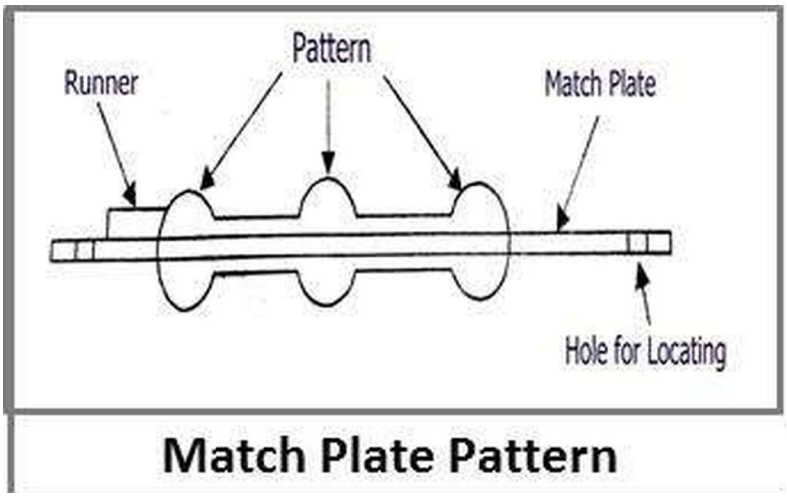
Diagram Description: A cylindrical object with a flange at the center, split horizontally into two halves with alignment pins.



2. Match Plate Pattern:

- Patterns for cope and drag are mounted on opposite sides of a single plate (match plate)
- The plate acts as the parting plane
- Ensures perfect alignment of cope and drag halves
- Used for mass production of small castings

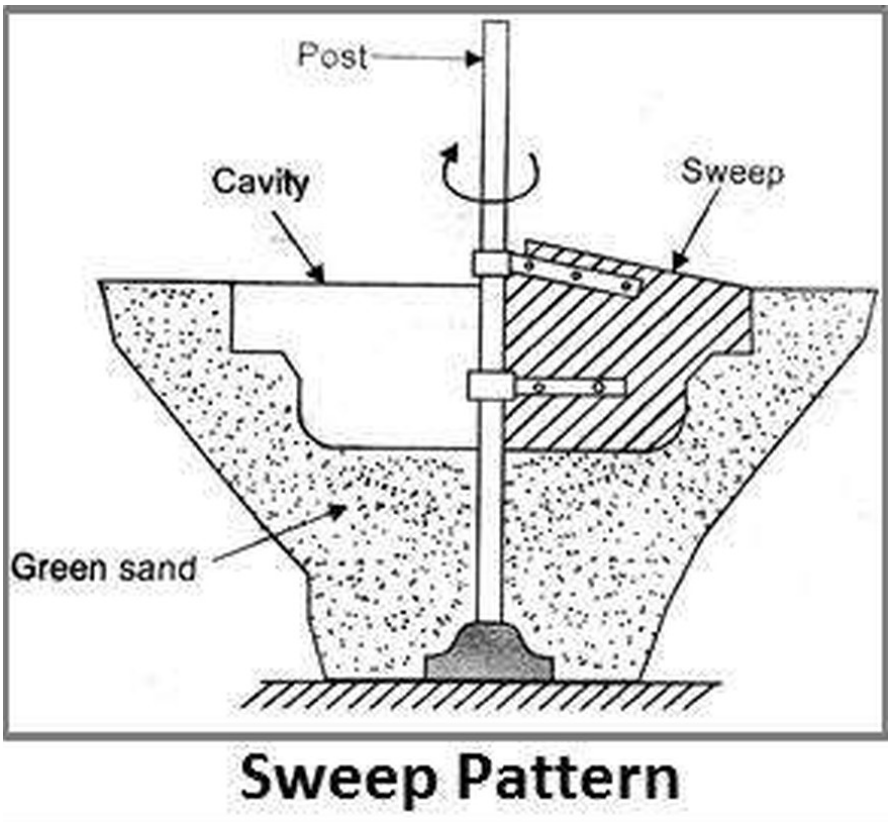
Diagram Description: A flat rectangular plate with upper pattern half on top surface and lower pattern half on bottom surface, with sprue and runner system attached.



3. Sweep Pattern:

- A sweep (template) rotates about a central axis to form the mould cavity
- Used for large, symmetrical, circular castings (e.g., bells, pipes, gears)
- Eliminates need for full-sized pattern
- Economical for large diameter objects

Diagram Description: A vertical spindle with a horizontal arm (sweep) attached at one end; the sweep rotates in a circular path to scrape sand and form a bell-shaped cavity.



Other Important Questions:

1. Patterns Used in Foundry Practice:

- **Q.** Name the various patterns that are normally encountered in the foundry practices. **(SUMMER 2023, 3 Marks)**

Answer:

Patterns Used in Foundry:

- **Solid (Single-piece) Pattern** – Simple shapes without undercuts
- **Split Pattern** – Two halves for complex shapes
- **Match Plate Pattern** – Cope and drag mounted on one plate
- **Cope and Drag Pattern** – Separate patterns for cope and drag
- **Gated Pattern** – Multiple patterns with attached gating system
- **Sweep Pattern** – Rotating template for large circular shapes
- **Skeleton Pattern** – Frame with strickling board for large hollow shapes
- **Loose Piece Pattern** – Detachable pieces for undercut features

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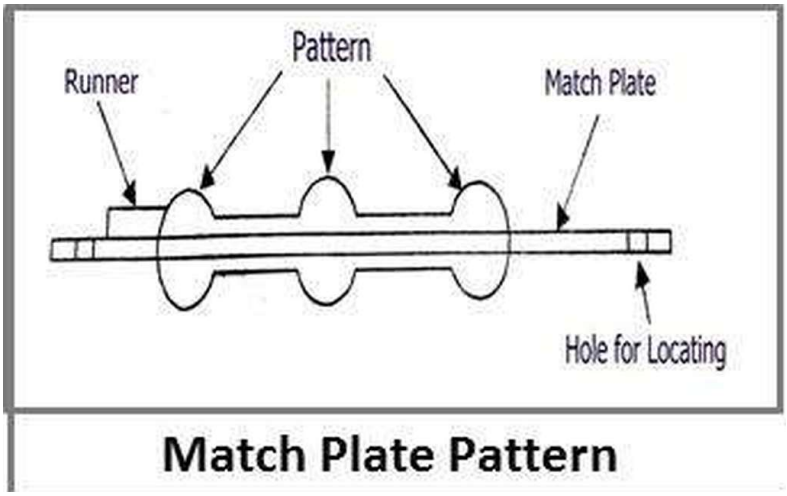
- **Q.** Explain following patterns with neat sketch: i) Match plate pattern ii) Gated patterns **(WINTER 2023, 4 Marks)**

Answer:

i) Match Plate Pattern:

- A single metal or wooden plate (match plate) on which cope pattern is mounted on top and drag pattern on bottom
- The plate itself forms the parting line between cope and drag
- Sprue, runner, and gates are attached to the plate
- Ensures accurate alignment and saves moulding time

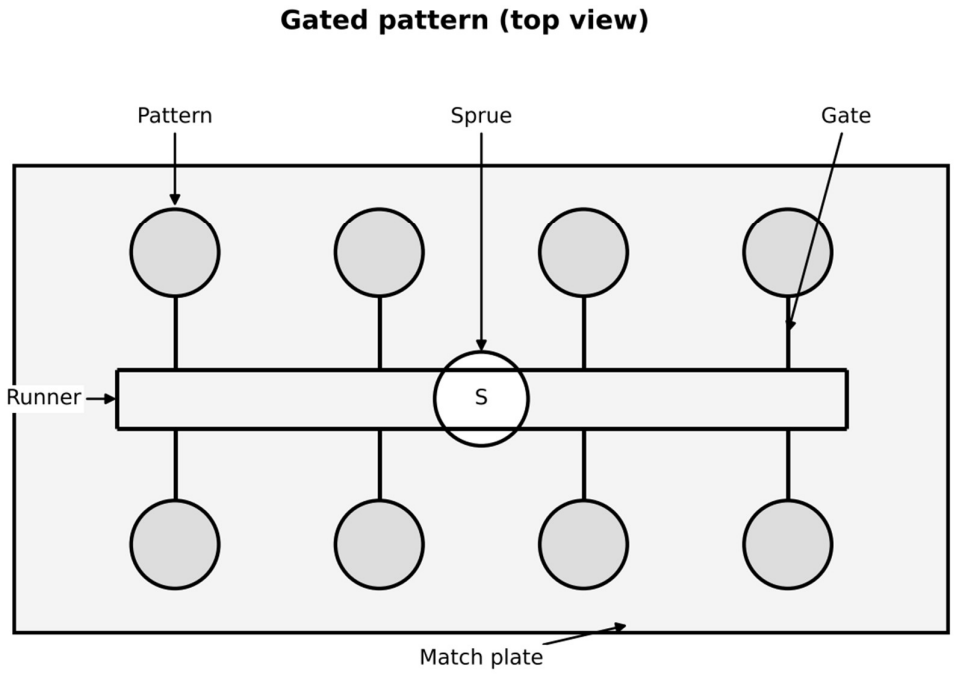
Diagram Description: A flat rectangular plate with upper half of pattern protruding above and lower half below; gating system channels are also attached to the plate.



ii) Gated Pattern:

- Multiple small patterns are connected by a common gating system (runners and gates)
- All patterns are mounted on a single plate with gates attached
- Allows pouring multiple cavities in one mould
- Used for mass production of small parts (e.g., nuts, bolts, washers)

Diagram Description: A rectangular plate with several small identical patterns arranged in rows, connected by horizontal runner channels and vertical gates leading to each cavity.



- **Q.** With the help of a neat sketch explain where sweep patterns are employed. **(SUMMER 2023, 3 Marks)**

Answer:

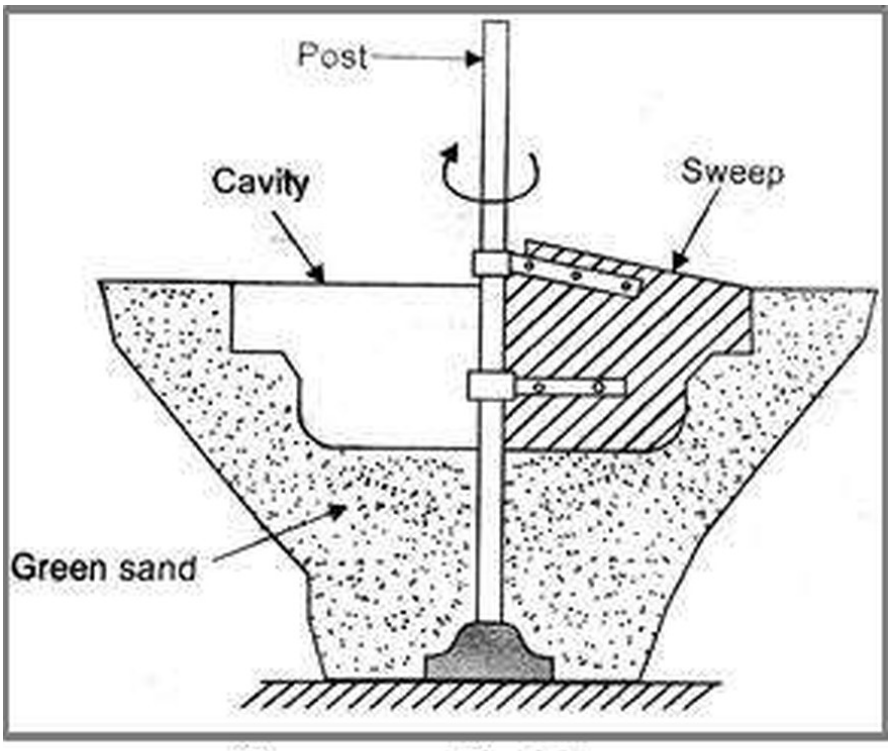
Sweep Pattern – Application & Explanation:

- **Definition:** A sweep pattern uses a rotating template (sweep) fixed to a central spindle to form the mould cavity by scraping sand.

Where Employed:

- Large circular or symmetrical castings (e.g., bells, large pipes, flywheels, rings)
- Objects with circular cross-section and large diameter (typically > 1 meter)
- Situations where a full-sized pattern would be too expensive, heavy, or difficult to handle
- Small quantity production of large circular parts
- **Working:** The spindle is set at the center of the mould, and the sweep arm is rotated around it, scraping excess sand to form the desired bell-shaped or conical cavity.

Diagram Description: A vertical spindle fixed at the center of a sand bed; a horizontal arm (sweep) attached to the spindle at one end; the sweep is rotated in a circular path to scrape sand and form a large bell-shaped cavity in the drag box.



Sweep Pattern

- **Q.** Explain (1) Sweep pattern (2) Match plate pattern with neat sketch. **(SUMMER 2026, 7 Marks)**

Answer:

(1) Sweep Pattern:

- **Definition:** A sweep pattern is a rotating template (sweep) that is revolved around a central vertical axis to form the mould cavity by scraping away excess sand.

Construction:

- Consists of a vertical spindle fixed at the center of the moulding box
- A horizontal arm (sweep) attached to the spindle, shaped to the desired profile
- The sweep may be full (360°) or half (180°) depending on the shape

Working:

- The spindle is positioned at the center of the moulding box
- Sand is filled and rammed around the spindle
- The sweep arm is rotated about the spindle, scraping excess sand and forming the cavity
- The spindle and sweep are removed, leaving the shaped cavity

Applications:

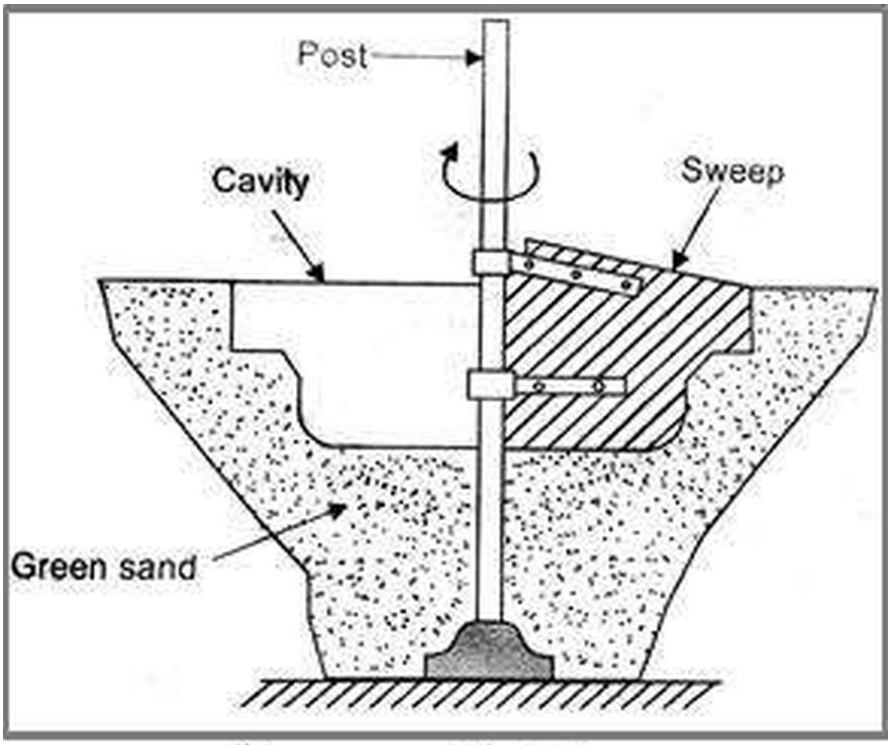
- Large circular castings (bells, pipes, gears, flywheels)
- Objects with rotational symmetry
- Large diameter objects where full pattern is uneconomical

Advantages:

- Saves pattern material and cost for large circular objects

- Easy to store and handle compared to large full patterns
- Can produce large cavities with simple equipment

Diagram Description: A vertical spindle with a horizontal sweep arm attached; the arm is rotated around the spindle in a circular path; the sweep scrapes sand to form a bell-shaped or conical cavity in the moulding box.



Sweep Pattern

(2) Match Plate Pattern:

- **Definition:** A match plate pattern consists of cope and drag patterns mounted on opposite sides of a single plate (match plate), which forms the parting line between cope and drag.

Construction:

- A flat metal or wooden plate (match plate) of size equal to the moulding box
- Upper half of pattern mounted on top surface (cope side)
- Lower half of pattern mounted on bottom surface (drag side)
- Gating system (sprue, runner, gates) also attached to the plate
- Alignment pins ensure proper registration

Working:

- The match plate with patterns is placed between cope and drag boxes
- Sand is rammed in both cope and drag simultaneously
- The mould is separated along the match plate
- The match plate is removed, leaving the cavity in both halves
- Cope and drag are reassembled for pouring

Applications:

- Mass production of small to medium castings
- Parts requiring high dimensional accuracy and interchangeability
- Automotive components, small machine parts, hardware items

Advantages:

- Ensures perfect alignment of cope and drag
- Saves moulding time (one plate handles both halves)
- Suitable for machine moulding and automated production
- Reduces pattern storage space

Diagram Description: A rectangular flat plate; upper half of a cylindrical pattern with flange protrudes from the top surface; lower half of same pattern protrudes from the bottom surface; gating channels (sprue, runner, gates) are also attached to the plate surface.

Match plate pattern (side view)

