GUJARAT TECHNOLOGICAL UNIVERSITY

BE-4 SEMESTER – OLD PAPER – S22 TO W25 – QUESTION BANK SOLUTION

Subject Name & Code:
Manufacturing Processes (3141908)

📚 UNIT 1: Introduction to Machine Tools

Q.1 – Give the detailed classification of machine tools. (3 marks)
Appeared in: S25, W23, W22, S24 (each 3 marks)
Ans:
Machine tools are classified as:

- **By cutting motion:** Rotational (lathe, drill) vs. Reciprocating (shaper, planer)
- **By operation:** Turning, Drilling, Milling, Grinding, Broaching, Sawing
- **By automation:** Manual, Semi-automatic, Automatic (CNC)
- **By number of axes:** 2-axis, 3-axis, 5-axis
- **By size/portability:** Bench type, Floor type, Heavy duty

Real-world application: CNC lathes (rotational, multi-axis) are standard in automotive part manufacturing.

Q.2 – Describe primary and auxiliary motions in machine tools. (4 marks)
Appeared in: S25(4), W25(3), W24(4), W23(4), W22(4), S22(4) → Highest: 4 marks
Ans:

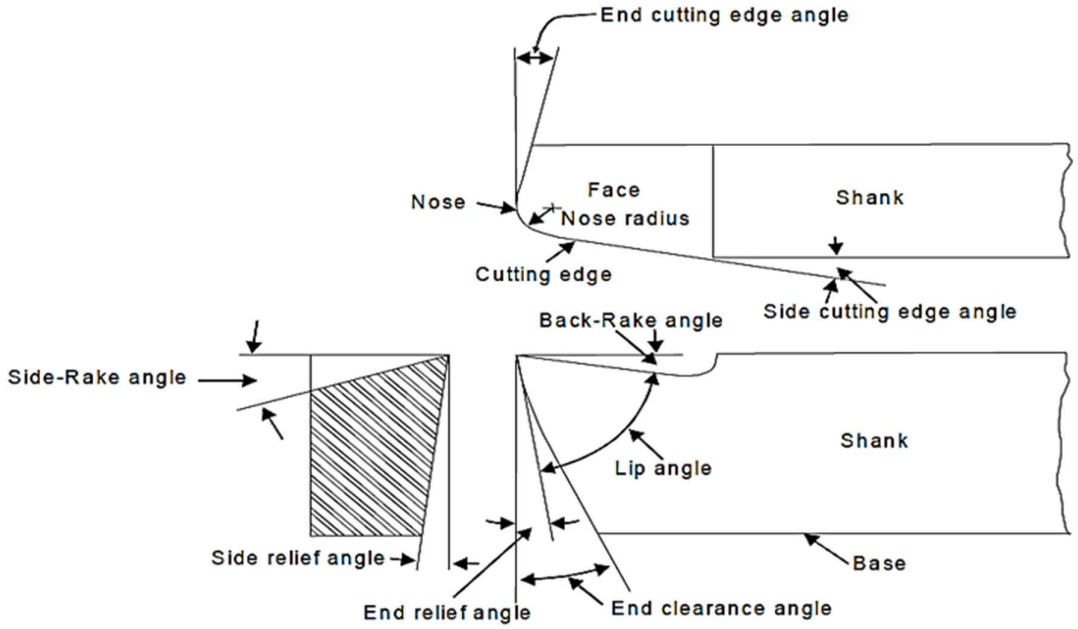
Motion Type	Definition	Example in Lathe
Primary (cutting)	Directly removes material (rotary or linear)	Rotation of workpiece (spindle)
Auxiliary (feed)	Gradually positions the cutting edge	Longitudinal feed of tool carriage

Key points:

- Primary speed determines cutting velocity (m/min).
- Auxiliary motion can be continuous or intermittent.
- In drilling, primary = drill rotation, auxiliary = drill feed.

Example: In a shaper, primary = reciprocating ram, auxiliary = table feed after each stroke.

Q.3 – Illustrate single-point cutting tool geometry and tool signature with sketch. (7 marks)
Appeared in: S25(7), W25(7), W24(7), W23(7), W22(7) – Highly repeated
Ans:
Definition: Single-point cutting tool has one cutting edge (e.g., lathe tool). Tool signature is a numerical code describing its angles.
[DG]



Single point cutting tool geometry

Tool signature (ASA):
αb – αs – γe – γs – ϕe – ϕs – r (mm)
Example: **8 – 14 – 6 – 6 – 6 – 15 – 1.2**
Real-world application: Choosing high back rake (up to 20°) for aluminium, zero or negative for cast iron.
Advantages of proper geometry:

- Reduces cutting force and heat
- Improves surface finish
- Extends tool life

Limitations: ASA obsolete; replaced by ORS (ISO) system, but still taught for concept.

Q.4 – Draw single-point cutting tool and explain tool signature as per ASA. (7 marks)
Appeared in: S24(7), S23(7)
Ans:
Same as Q.3 above (ASA system). Add:

- **Back rake angle (αb):** Controls chip flow direction.
- **Side rake angle (αs):** Reduces cutting force.
- **End relief (γe):** Prevents rubbing.
- **Side relief (γs):** Allows feed motion.
- **End cutting edge angle (ϕe):** Influences tool strength.
- **Side cutting edge angle (ϕs):** Increases tool life by distributing wear.
- **Nose radius (r):** Improves finish.

[DG PROMPT] *Same as Q.3*

Q.5 – Differentiate between orthogonal and oblique cutting. (3 marks)
Appeared in: S23(3), W24(3)
Ans:

Parameter	Orthogonal	Oblique

Parameter	Orthogonal	Oblique
Cutting edge orientation	Perpendicular to velocity	Inclined at angle (i)
Chip flow direction	Along rake face normal	At an angle (chip flow angle)
Force components	2 (cutting & thrust)	3 (including transverse)
Example	Shaping, parting	Turning, milling

Conclusion: Oblique cutting is more realistic for most industrial processes.

Q.6 – Explain primary motion and secondary motion in centre lathe. (3 marks)
Appeared in: S23(3), W24(3)
Ans:

- **Primary motion (cutting):** Rotation of workpiece (chuck/spindle) – provides cutting speed.
- **Secondary motion (feed):** Longitudinal movement of carriage (apron) – moves tool along job length.
- **Auxiliary motion:** Cross feed for facing, threading lead screw engagement.

Example: Turning operation – primary = 600 rpm, secondary = 0.2 mm/rev.

Q.7 – Define Machine tool along with its classification. (3 marks)
Appeared in: W25(3)
Ans:
Machine tool: A power-driven machine that removes metal in the form of chips to achieve desired shape, size, and finish.
Classification (brief):

- **By type of chip removal:** Lathes (rotary work), Drills (rotary tool), Shapers (linear), Milling (multi-point)
- **By degree of automation:** Conventional, NC, CNC

Q.8 – Why are cutting forces measured? What are the different ways to measure cutting forces? (4 marks)
Appeared in: S24(4)
Ans:
Reasons for measurement:

- Estimate power consumption & motor sizing
- Design tool geometry & machine stiffness
- Monitor tool wear & chatter
- Optimize cutting parameters (speed, feed, depth)

Measurement methods:

1. **Dynamometer (strain gauge type):** Measures three orthogonal components (Fx, Fy, Fz).
2. **Piezoelectric dynamometer:** High frequency response for dynamic forces.
3. **Indirect method:** Measure spindle motor current or power draw.

Example: A lathe tool dynamometer gives Fz (cutting force) ≈ 1200 N for steel at 0.5 mm/rev feed.

Q.9 – What are the basic requirements of machining processes? (4 marks)
Appeared in: W24(4)
Ans:

1. **Relative motion** (primary + feed) between tool and workpiece
2. **Cutting tool** with proper geometry & material (HSS, carbide, ceramic)
3. **Work holding device** (chuck, vise, fixture)
4. **Machine rigidity** to withstand cutting forces without deflection
5. **Cutting fluid supply** for cooling & lubrication

Real-world: CNC machining centres satisfy all requirements with automatic tool changers and coolant systems.

Q.10 – Explain with diagram: working and auxiliary motions in machine tools. (4 marks)
Appeared in: W22(4)
Ans:
[DG]

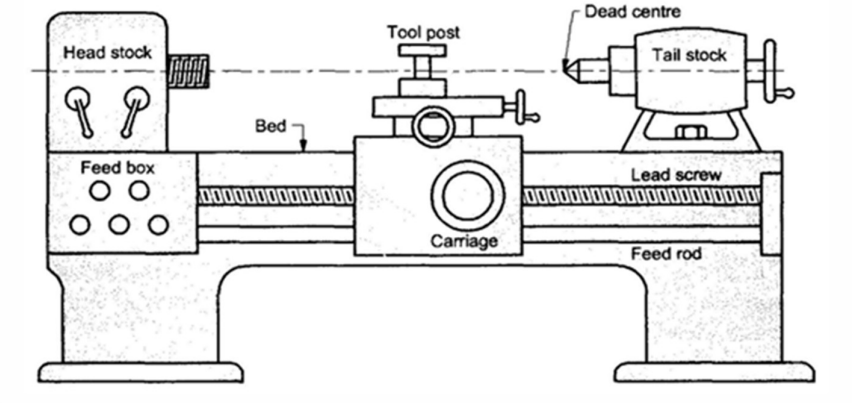
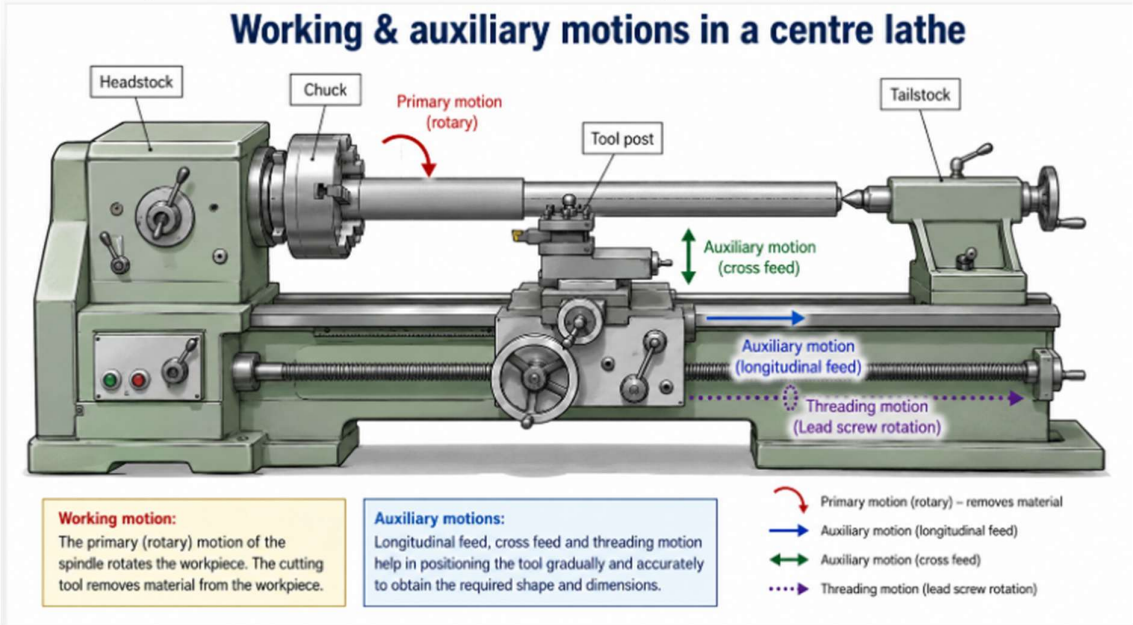


Fig.2.2 Parts of Lathe Machine

(Below Image For reference for **working and auxiliary motions)**



Working Motions (Cutting Motions):

- **Primary/Cutting Motion:** Main movement causing chip removal; consumes maximum power.
    - Example: Workpiece rotation in lathebbvn n, drill rotation in drilling.
- **Feed Motion:** Brings fresh material into contact with tool.
    - Example: Tool movement along bed in lathe.

Auxiliary Motions (Non-Cutting Motions):

- Motions that support machining but do not directly remove material.
- **Approach motion:** Moving tool towards workpiece.
- **Return motion:** Quick return in shaper/slotter to reduce idle time.
- **Indexing motion:** Rotating workpiece to new cutting position (milling).
- **Relieving motion:** Retracting tool to avoid rubbing during return stroke.
- **Clamping/Unclamping:** Holding and releasing workpiece.
